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DOUBLE NORMAL-INCIDENCE ULTRAVIOLET GRATING SPECTROMETER.(U)

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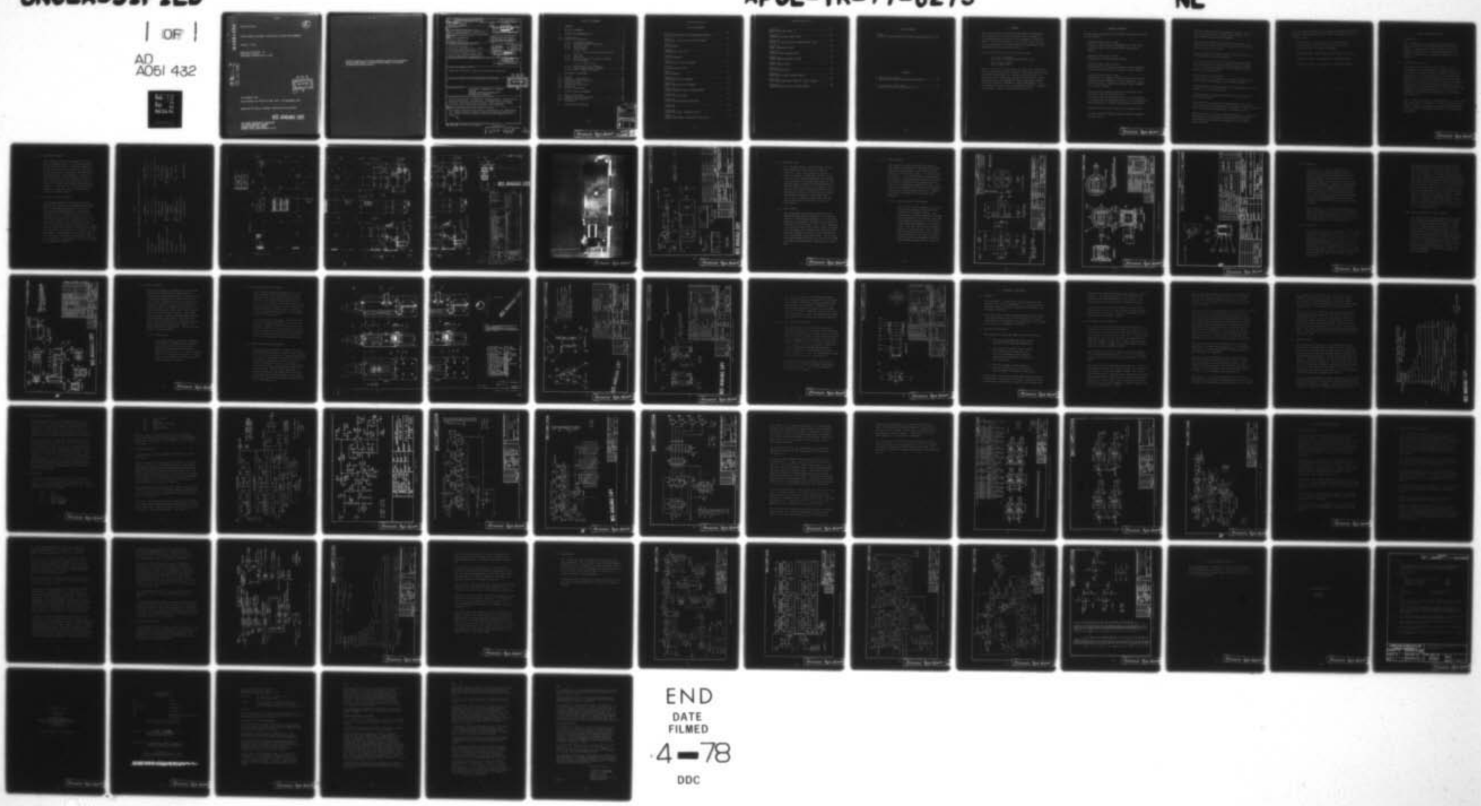

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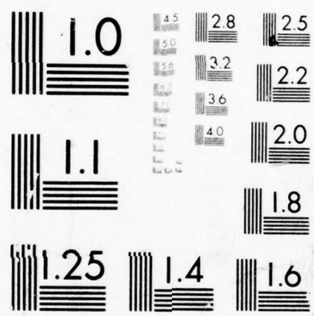

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DOUBLE NORMAL-INCIDENCE ULTRAVIOLET GRATING SPECTROMETER

Joseph P. Padur

Comstock & Wescott, Inc.
765 Concord Avenue
Cambridge, Massachusetts 02138

30 November 1977

Final Report for Period 21 May 1975 - 30 September 1977

AIR FORCE GEOPHYSICS LABORATORY
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
HANSCOM AFB, MASSACHUSETTS 01731

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Page 95
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report describes the design, development, and fabrication of a double normal incidence ultraviolet grating spectrometer for sounding rockets and the field services supporting its launch.

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APPENDIX

1. GENERAL

This report covers the design, development, and engineering activities of Comstock & Wescott, Inc. in support of a research program of the Air Force Geophysics Laboratory (AFGL). The work discussed in this report covers the design, development, and fabrication of a double-deck normal incidence grating spectrometer (RS-62).

The principal engineers on this contract were

Mr. John F. McGrath,
Director of Mechanical Engineering, and

Mr. Joseph P. Padur,
Project Physicist.

Work in the field of electronics, including the flight electronics and ground support equipment (GSE), was subcontracted to TRI-CON Associates, Inc. and was conducted under the direction of Mr. Chester G. Kuczun and Mr. Robert S. Hills. Other technical contributors to the contract were Messrs. Charles W. Peterson, William F. Burke, and George W. Guay of Comstock & Wescott, Inc., and Messrs. Norbert F. Robertie and Timothy A. Doyle of TRI-CON Associates, Inc.

2. RELATED CONTRACTS

The following contracts have preceded the contract covered by this report:

AF19(604)-1097, 1954 to 1956.
Contract concerned with development of a soft X-ray radiation source and an associated high vacuum system.

AF19(604)-1889, 1956 to 1959.
Measurements of EUV and soft X-rays.

AF19(604)-5693, 1959 to 1961.
Investigation of extreme ultraviolet solar radiation and clarification of role of photoelectron emission.

AF19(604)-7496, 1960 to 1963.
Development of a number of rocket and satellite monochromators and retarding potential detectors. Specific reference is made to the Final Report AFCRL-64-773 of this contract.

An associated contract which ran concurrently with AF19(604)-7496 was AF19(628)-2975.
This was concerned with research into the photoemission properties of materials and with the investigation and development of various spectroscopic instruments.

AF19(628)-4317 was an extension of AF19(604)-7496.

Contract AF19(628)-5188 covered a further extension of this work.

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Contract F19628-67-C-0205 covered the design, development and construction of three flight quality EUV spectrophotometers for OGO-F Mission.

Contract F19628-68-C-0239 covered an extension of the work performed under a former contract and preceded the work covered by this report.

Contract F19628-72-C-0048 covered a modification of a Double-Deck EUV Spectrophotometer.

Contract F19628-72-C-0254 covered design, development, and fabrication of a double spectrophotometer consisting of one grazing incidence and one normal incidence grating spectrophotometer.

F19628-73-C-0253, 1973-1976.
Development and fabrication of two solar extreme ultraviolet double spectrometers for sounding rockets.

F19628-74-C-0002 covered a Type II normal-incidence extreme ulraviolet grating spectrometer.

F19628-76-C-0041 covered the modification of Solar EUV spectrometer RM-60.

F19628-76-C-0235 covered the refurbishment, testing and field services for an ultraviolet spectrometer and electronics for an electron spectrometer for a sounding rocket.

F19628-76-C-0294 cover the design, fabrication, integration and preparation for launch of a double-deck solar EUV spectrometer and auxiliary experiments for a sounding rocket payload.

Other contracts carried out by Comstock & Wescott in the field of space instrumentation, but not directly related to this contract, are:

AF19(628)-253 - Research directed toward design of instrumentation for investigation of aerospace by rocket and satellite probe techniques.

AF19(628)-4988 - Rocket and satellite probe techniques.

F19628-68-C-0307 - Continuation of AF19(628)-4988.

F19628-72-C-0027 - Continuation of F19628-68-C-0307.

3. ROCKET SPECTROMETER RS-62

3.1 Introduction

This instrument was a double-deck near-normal-incidence spectrometer of an Ebert-Fastie configuration capable of measuring the solar continuous spectral intensity distribution in the wavelength range from 1300Å to 3500Å with an instrumental bandwidth of 0.1 Angstroms.

3.2 Technical Description

The spectrometer consisted of two optical systems integrated in a single housing. A basic optical design under a previous contract (F19628-72-C-0254) was chosen because of its proven optical performance and adaptability to required payload envelope constraints. Except for the housing, the optical systems had separate mechanical, optical, and electronic components which allowed them to be used separately. Each system had the mechanical capability of continuous or single step coverage of the wavelength range from central image to 4000 Angstroms.

Table I lists the technical characteristics of this instrument which will be referred to as RS-62 throughout this report. Figure 1 illustrates the main assembly drawing of this double spectrometer and Figure 2, a reproduced photograph.

3.2.1 Instrument Housing

The instrument housing was manufactured from 6061-T6 aluminum alloy. It was manufactured in two halves for ease of internal machining and joined by brazing at Brazonics Corporation in Amesbury, Mass. according to brazing specification MPS-161 (see Appendix). This was accomplished only after acceptance of two test braze housings which were manufactured and brazed to simulate the actual housing brazing operation. The interior of the instrument was etched to a fine matte finish and black anodized for minimum scatter.

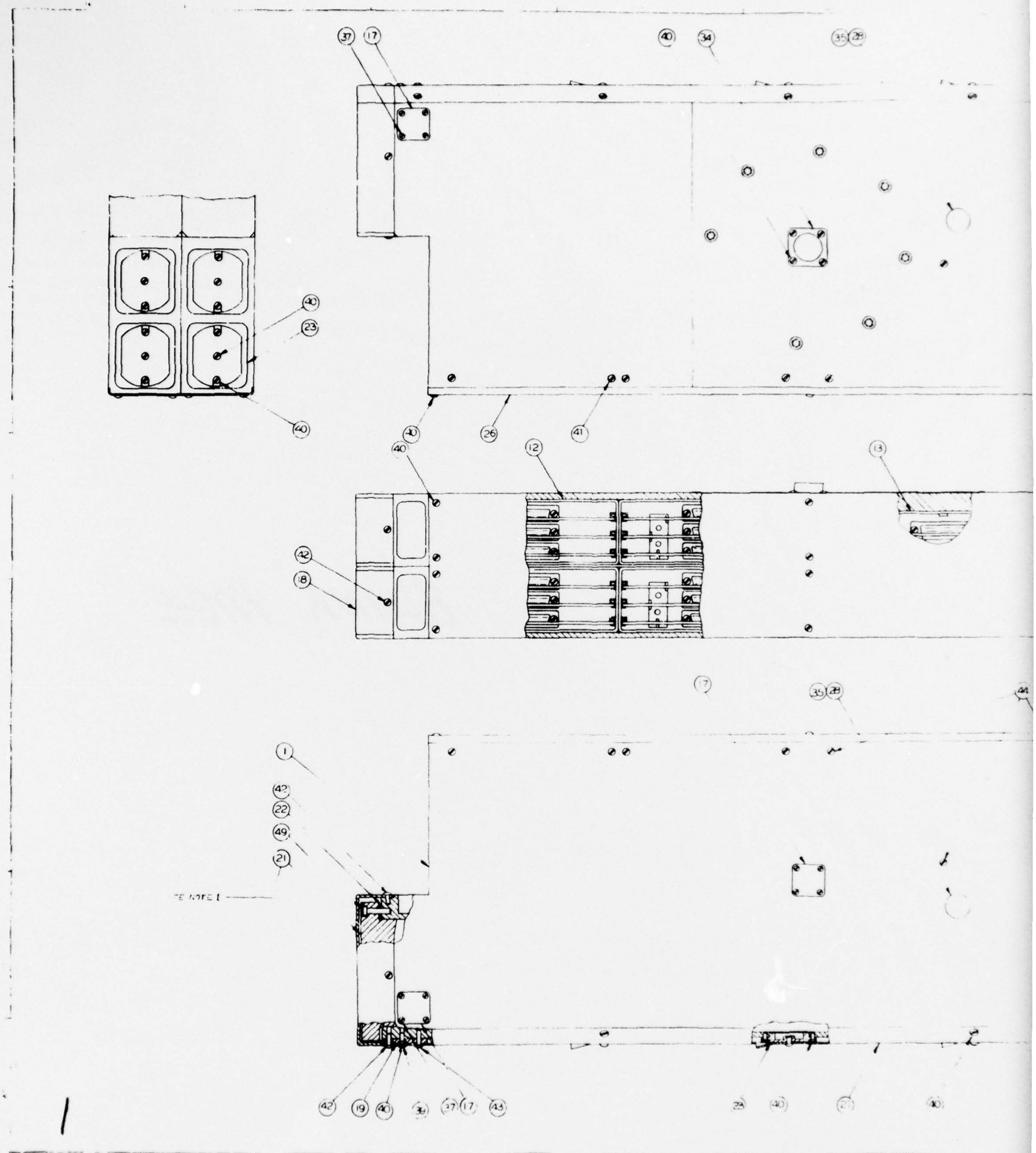
3.2.2 Entrance and Exit Apertures

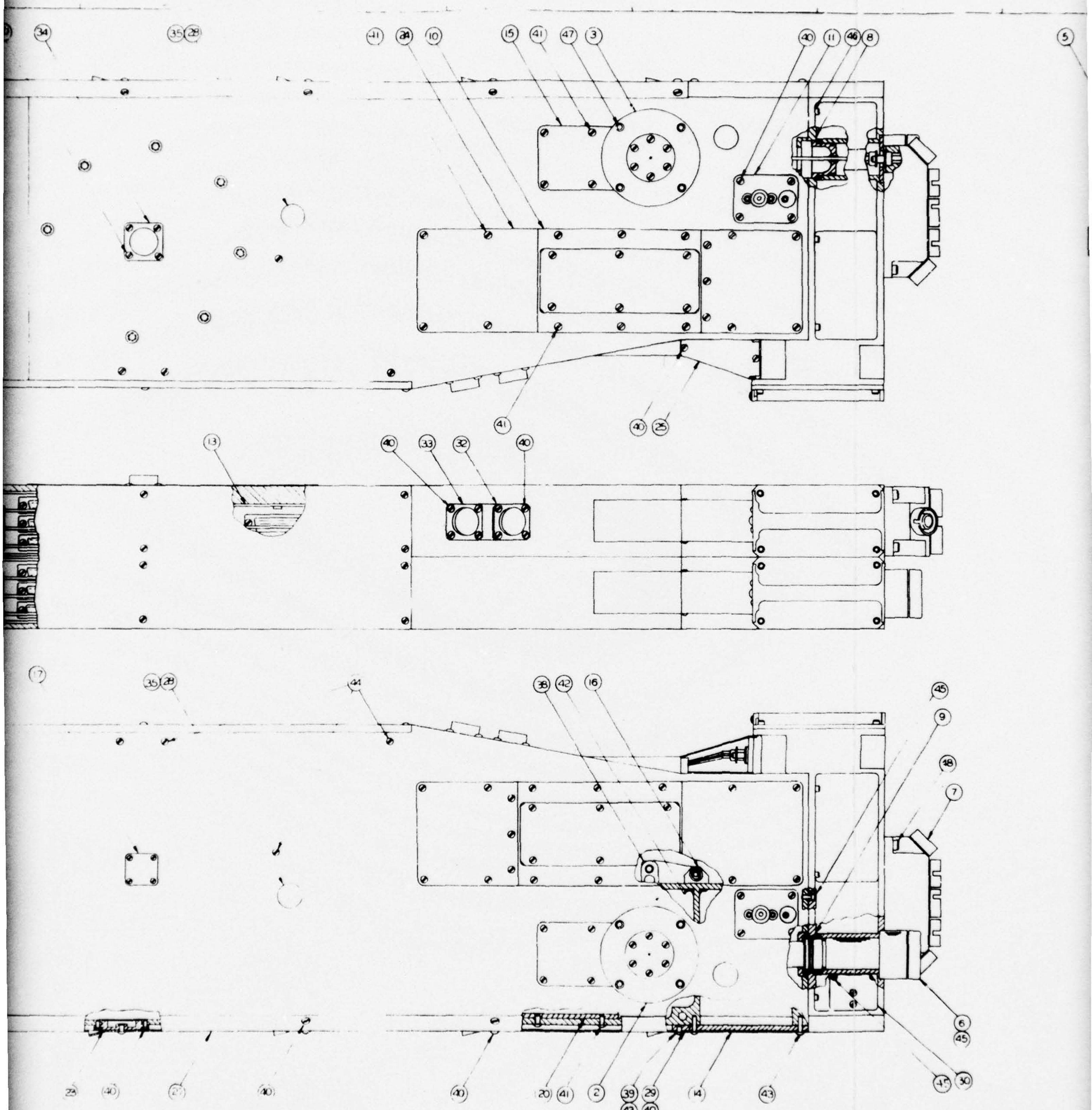
The entrance apertures of both spectrometers consisted of bimetal electroformed slits assembled in housings along with the exit slits (also bimetal electroformed) to parallelism tolerances of 10^{-4} radians or better. The entrance slit for the top deck was .0015 inch (37 microns) wide by six millimeters high. The bottom deck entrance slit dimension was .001 inch (25.4 microns) wide by six millimeters high. The exit slits were matched in width to the respective entrance slits and were 6.4 mm high for both instruments. Verification of the actual dimensions was made, recorded and supplied to AFGL for use in solar flux calculations. The slit assembly is illustrated in Figure 3.

TABLE I

TECHNICAL CHARACTERISTICS OF ROCKET SPECTROMETER NO. 62

	Top Deck	Bottom Deck
Entrance Slit	.0015" x 6 mm	.001" x 6 mm
Exit Slit	.0015" x 6.4 mm	.001" x 6.4 mm
Grating	3600 ℓ/mm B&L #35-53-04-170	3600 ℓ/mm B&L #35-53-04-160
Flight Wavelength	1700Å - 3500Å	1300Å - 1800Å
Stepping Rate	300 STEPS/SEC	100 STEPS/SEC
Step Increment (Nominal)	12.3×10^{-6} inch .025Å/STEP	12.3×10^{-6} inch .025Å/STEP
Resolution	0.1Å FWHM	0.08Å FWHM
Filters	Bkg. - #7056 2 - Neutral Density	Bkg. - Sapphire
Auxiliary Equipment	Solar Viewing Photometer	
Detector	EMR 641F-06-18	EMR 641G-07-18

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Figu

REF	WIRING DIAGRAM		TRI-CON ASSOC.	
REF	HARNESS LAYOUT	D817	TRI-CON ASSOC.	
49	HEX SOC HD CAP SCREW	#8-32 x .75L	SST	6
48		#8-32 x .50L		REF
47		#6-32 x .31L		8
46		#4-40 x .38L		28
45	HEX SOC HD CAP SCREW	#4-40 x .25L		7
44	BINDING HD SCREW-SLOTTED	#4-40 x .62L		6
43		#4-40 x .50L		12
42		#4-40 x .38L		14
41		#4-40 x .31L		50
40		#4-40 x .25L		92
39		#4-40 x .19L		2
38		#4-40 x .12L		2
37	BINDING HD SCREW-SLOTTED	#2-56 x .19L	SST	2
36				
35	RETAINING RING	5103-62	TRUARC	4
34	CONNECTOR	TO2A-14-35P		1
33		TO2A-14-18S		1
32	CONNECTOR	TO2A-14-15P		1
31	FILTER PORT [illegible]	A28[illegible]		1
30	RANGE CHANGE FILTER ASSEMBLY	C1293		
29	SINGLE BEVEL COVER SUPPORT	A2803		1
28	PLUG - DOWEL HOLE	A2801		4
27	VENT COVER	C1284		1
26	COVER - ELECTRONICS	C1286		1
25	COVER - CONNECTOR	B2188		2
24	COVER - ENCODER	B2187		2
23	VENT	B2013		12
22	MIRROR SHIM	A2734		6
21	EBERT MIRROR	C1275		2
20	CENTRAL IMAGE TRAP	B2199		2
19	DOUBLE BEVEL COVER SUPPORT	B2191		1
18	MIRROR COVER	B2190		2
17	MIRROR FORE COVER	A2804		3
16	GRATING SPRING LOAD ASSEMBLY	A2815		2
15	COVER - GRATING ACCESS	A2802		2
14	IFM PORT COVER ASSEMBLY	B2198		2
13	FORE ELECTRONICS FRAME ASSY	C1292		1
12	AFT ELECTRONICS FRAME ASSY	D852		1
11	BACKGROUND FILTER ASSEMBLY	C1287		2
10	DRIVE ASSEMBLY	E399		2
9	SLIT ASSEMBLY	D849-2		1
8	SLIT ASSEMBLY	D849-1		1
7	EYE BLOCK	D748	[illegible] REF.	REF
6	BAFFLE ASSEMBLY	[illegible]1140		1
5	DETECTOR AMP HOUSING ASSY	D853-[illegible]		1
4	DETECTOR/AMP HOUSING ASSY	D853-1		1
3	GRATING ASSEMBLY	D851-1		
2	GRATING ASSEMBLY	D851-2		1
1	HOUSING-MACHINING POST BRAZE	E4[illegible]		1

Figure 1. Main Assembly - Model 5033 Spectrophotometer

3

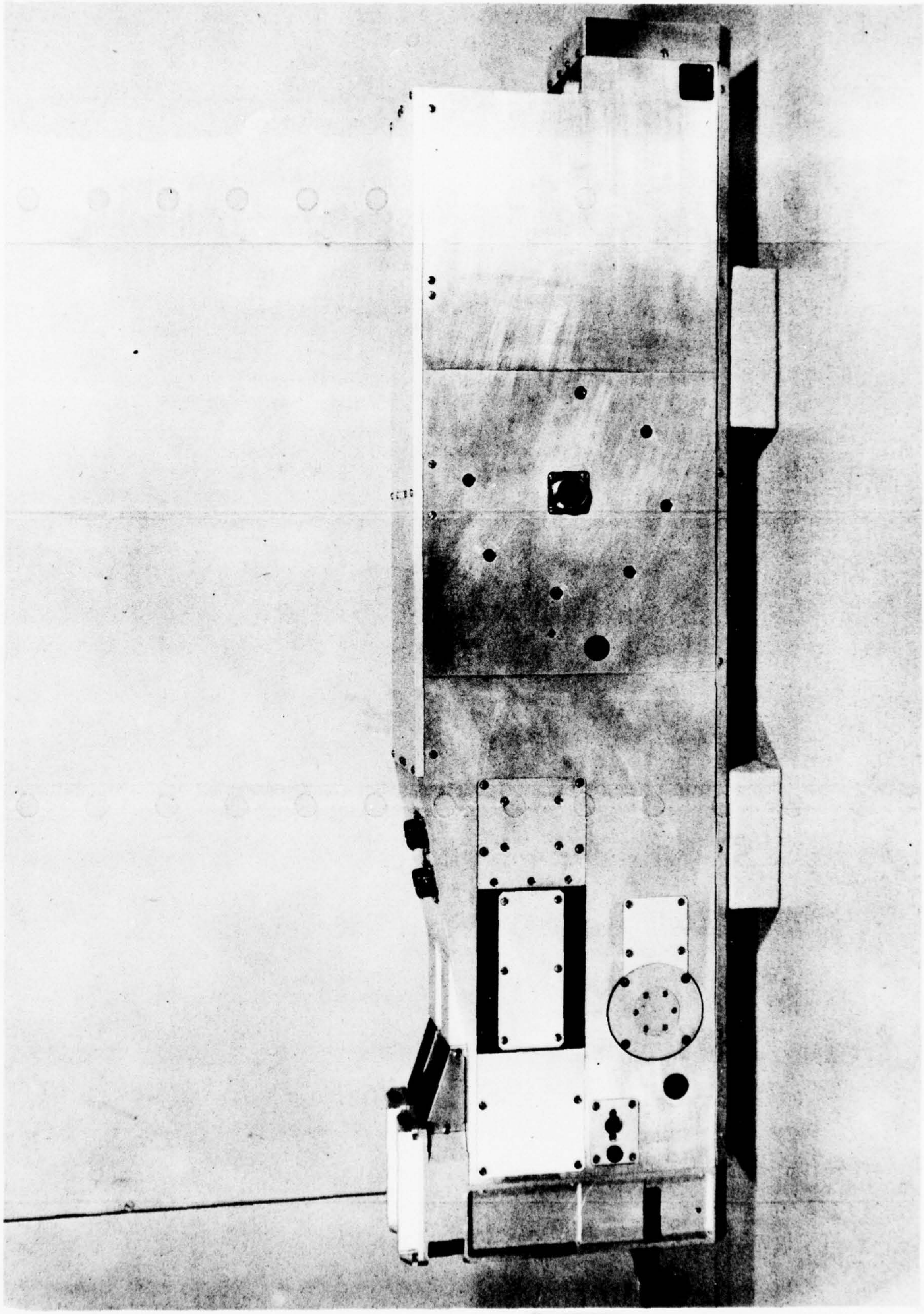

Figure 2. Bottom Deck View of RS-62

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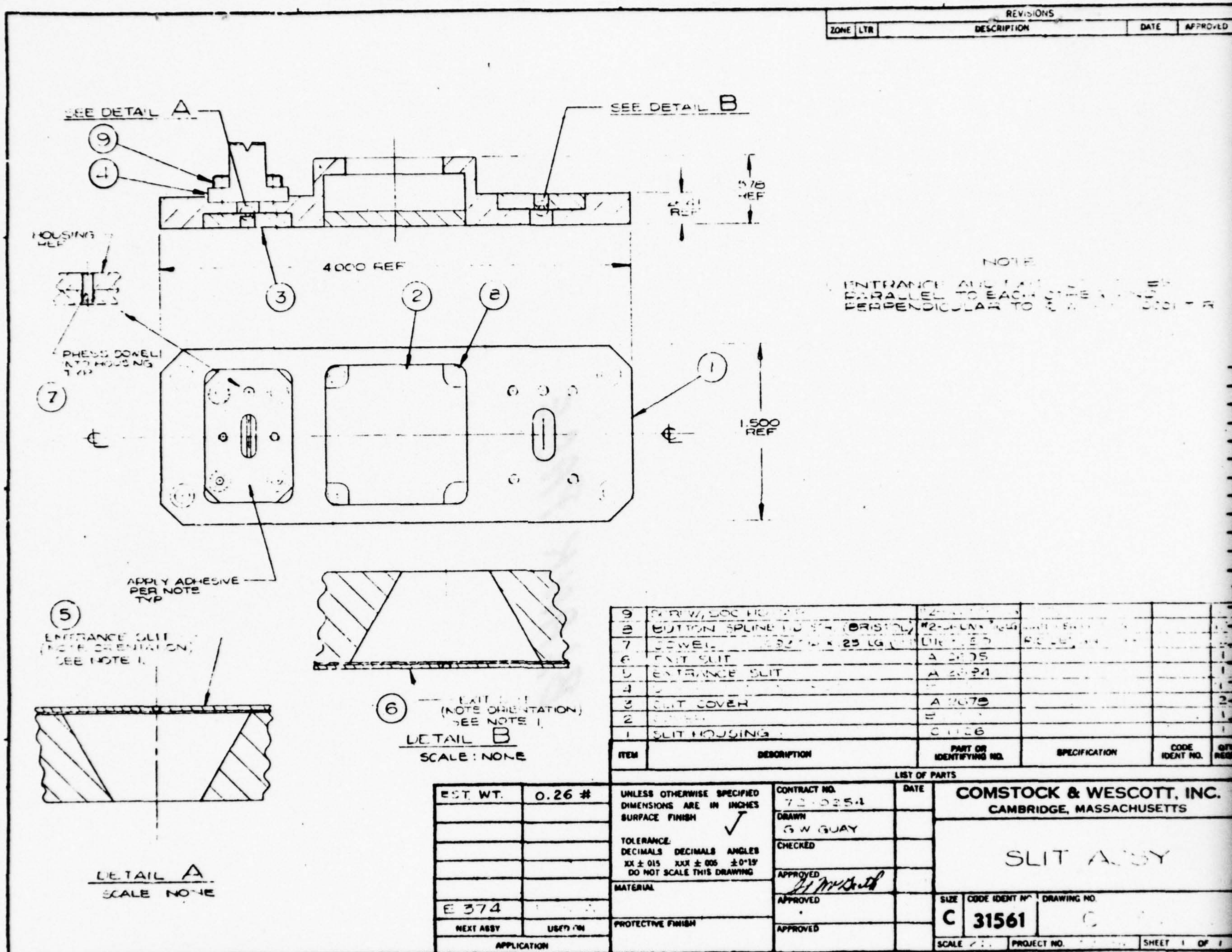

Figure 3. Slit Assembly

3.2.3 Aperture Stop

The entrance aperture for both decks incorporated aperture stops similar to that in Figure 4. These stops primarily served to limit the amount of radiation falling on the grating to the central maximum of the diffraction pattern of the largest wavelength in the spectral range covered by each spectrometer. Another stop was located on the mirror side of the exit slit which served as a baffle to all radiation not directly focused by the mirror. The immediate effect of this baffle was to assure that no radiation with less than two appropriate mirror reflections could enter the detector.

3.2.4 Ebert Mirror

The collimating and focusing mirror was also fabricated from 6061-T6 aluminum alloy and subjected to stabilizing treatments. The blank was machined to a spherical surface with a radius of curvature of 67.23 inches. After final machining the blank was electroless nickel coated, polished and overcoated with aluminum plus magnesium fluoride for maximum reflectivity and/or protection in the applicable wavelength range. Reflectance data were supplied for the two mirrors from 1216Å to 3500Å by Acton Research Corporation of Acton, Mass.

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3.2.5 Grating Mount

Past experiences have disclosed an unacceptable degree of deviation of the grating rulings from the perpendicular to one of the mounting surfaces of the grating blank. To overcome this deficiency, a new grating mount was designed to accommodate a grating/flange assembly that could be precisely assembled in the laboratory with the use of an additional assembly fixture. This design also eliminated the necessity of making a right and left hand grating lever arm. Figure 5 illustrates the design of the grating mount assembly.

3.2.5.1 Grating Spring Lead Assembly

This device exerted a nominal two pound load on the grating lever arm with a constant force negator spring. Its purpose was to assure repeatable angular step increments of the grating lever arm by eliminating backlash in the various interconnecting components of the drive train. This unit was mounted independently of the drive unit. This independent mounting facilitiated the installation and removal of the drive assembly during the optical alignment procedure. This assembly is depicted in Figure 6.

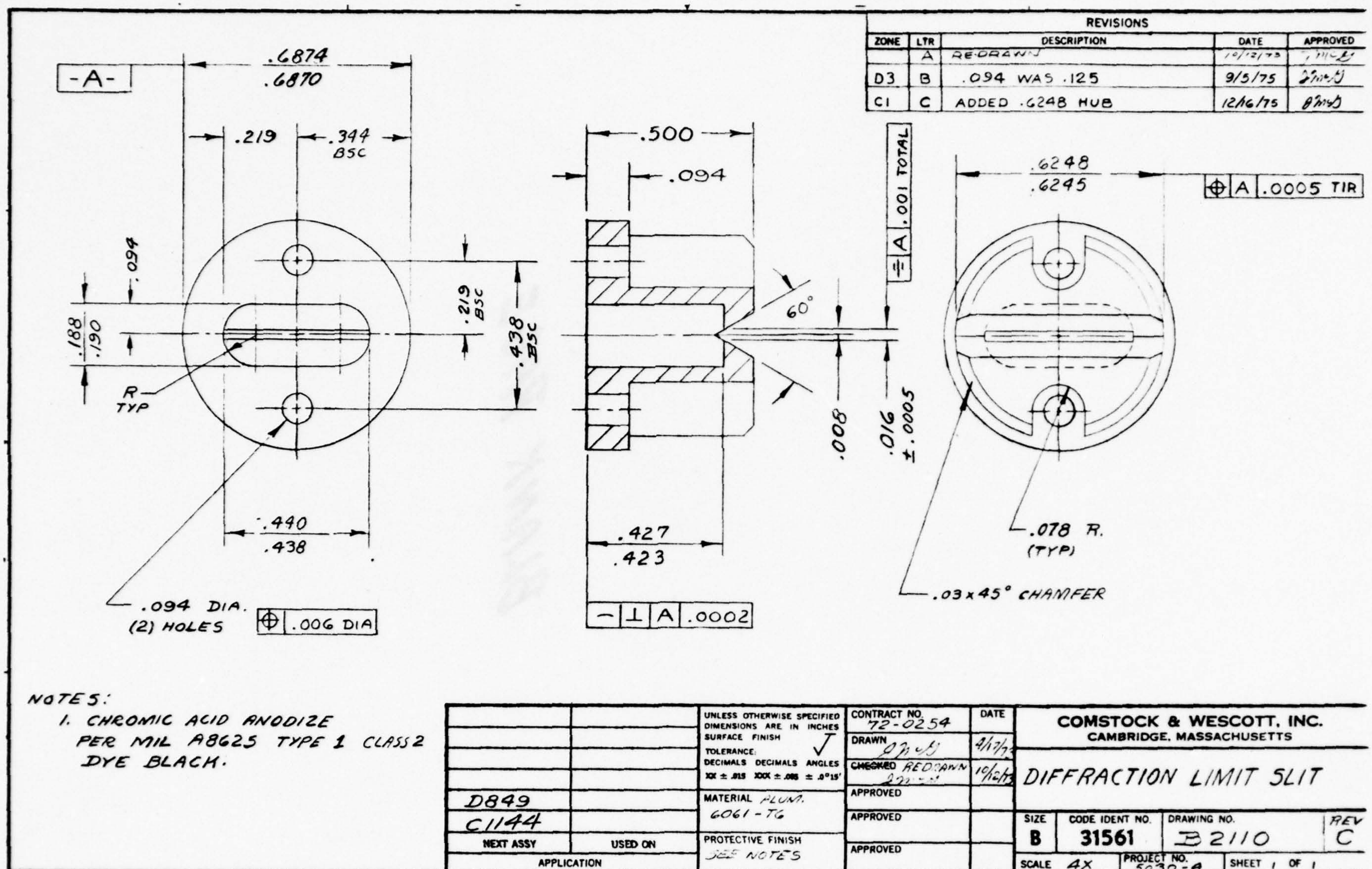

Figure 4. Diffraction Limit Slit

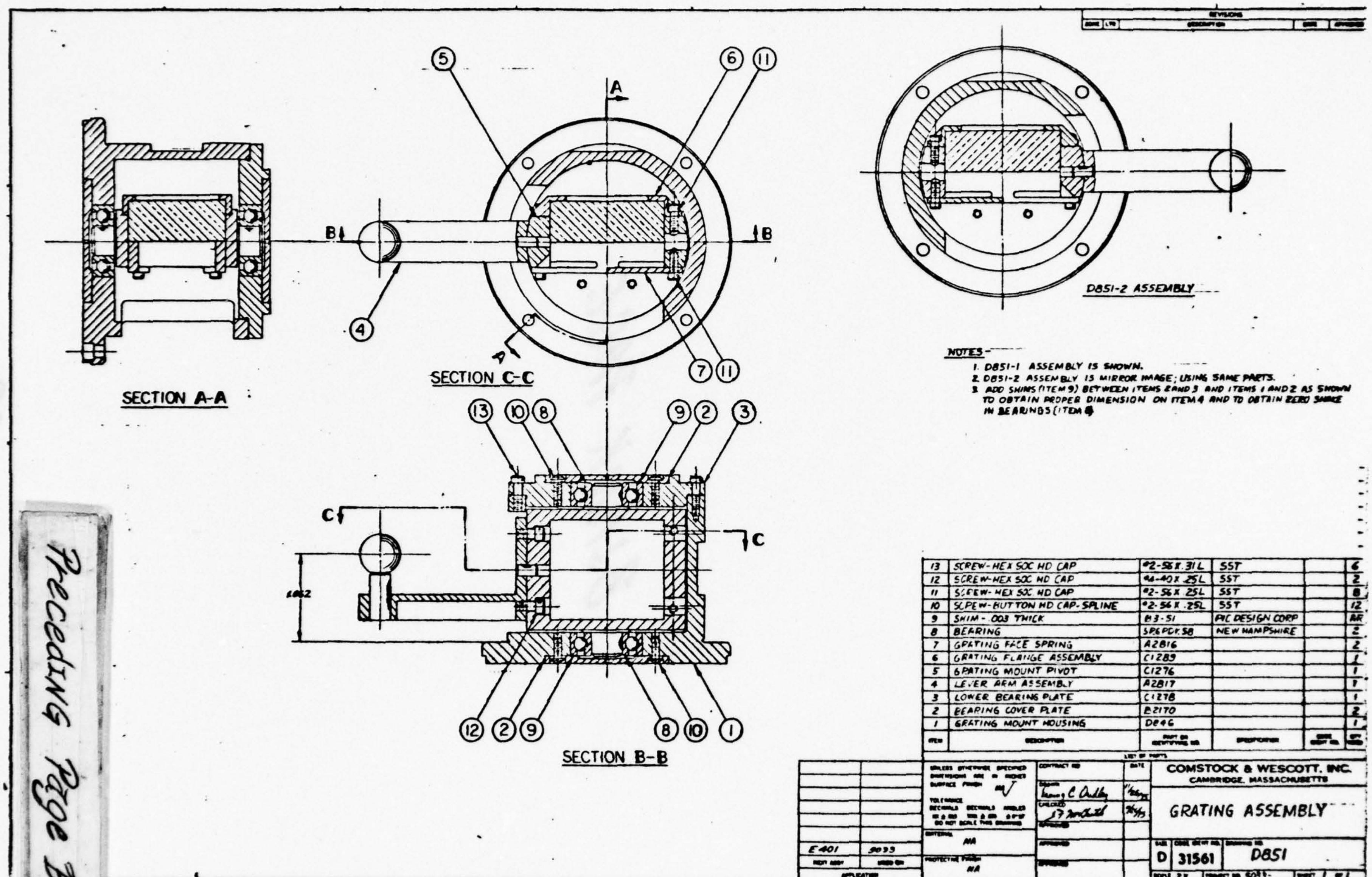

Figure 5. Grating Assembly

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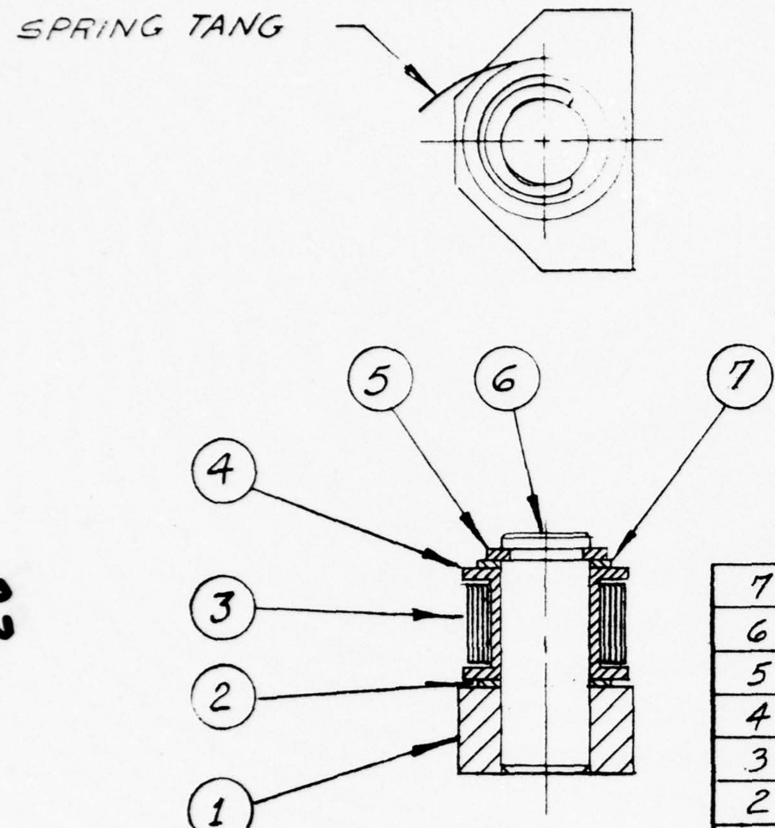

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7	SHIM - PIC B8 SERIES		AS REQ.
6	CAPSTAN SHAFT	A2814	1
5	RETAINER - TRUARC 5103-25		1
4	SPRING BOBBIN	A2710	1
3	NEGATOR SPRING, HUNTER SH4D14		1
2	SHIM - PIC B8-3		1
1	CAPSTAN BASE	A2813	1

NEXT ASSY: E 401	USED ON: 5033
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
SURFACE FINISH √
TOLERANCE: DECIMALS XX ± .015 DECIMALS XXX ± .005 ANGLES ± 0°15'
MATERIAL —
PROTECTIVE FINISH —

	DATE
CONTRACT NO. 75-0198	
DRAWN [illegible]	10/27/75
CHECKED	
APPROVED	
APPROVED	
APPROVED	

COMSTOCK & WESCOTT, INC.
CAMBRIDGE, MASSACHUSETTS

GRATING SPRING LOAD ASSY.

SIZE	CODE IDENT NO.	DRAWING NO.
A	31561	A2815
SCALE 2X	PROJECT NO. 5033-7	SHEET OF

Figure 6. Grating Spring Load Assembly

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3.2.6 Gratings

The diffraction gratings supplied with the instrument were standard plane reflective replicas from Bausch and Lomb with 3600 lines per millimeter. The blaze wavelengths were 2400Å and 1300Å, respectively, for the top and bottom spectrometers. Both were aluminum and magnesium fluoride overcoated for increased reflectivity at the shorter wavelengths and surface protection at the longer wavelengths. First order efficiency measurements were accomplished for both gratings at Acton Research Corporation and the data were supplied to AFGL personnel.

After delivery of the completed instrument to AFGL, the grating in the top deck (1700Å-3500Å) was replaced with a holographic grating (also 3600 lines per millimeter) by the AFGL scientists for further reduction of scattered light.

3.2.7 Detectors

The detectors used in both spectrometers were EMR sealed photomultipliers operated in a pulse counting mode. An EMR 641G-07-18 which has a calcium fluoride window and a cesium iodide photocathode with maximum sensitivity from 1250Å to 1900Å was utilized in the short wavelength spectrometer (lower deck) while an EMR 641F-06-18 with a fused silica window and a cesium telluride photocathode was used for the region from 1700Å to 3500Å (upper deck).

During preliminary acceptance testing at AFGL the EMR 641F-06-18 detector was found to be losing sensitivity. It was established that a leak had developed in the photomultiplier "pinch-off" seal. Attempts to replace it with another identical detector caused a temporary snag because the manufacturer had changed the outside diameter of this detector from 32 mm to 35 mm since others too were having trouble with the relatively unprotected "pinch-off" seal. The larger diameter detector supplied more protection with a thicker coating at the most vulnerable location. In order to accommodate this larger diameter detector, the detector-amplifier housing was remachined and then vacuum checked prior to reinstallation on the instrument housing.

3.2.8 Detector-Amplifier Housing Assembly

This assembly was a sealed vacuum tight compartment housing the photomultiplier, pulse amplifier, and high voltage power supply. It also served the added purpose of mounting a solar aspect sensor and photometer baffle. Prior to installation on the instrument housing, both assemblies were partially evacuated, pressurized with dry nitrogen, placed in a vacuum chamber at 10^{-6} Torr for several hours and then pressure tested. In both instances the detector housing maintained a positive pressure. Figure 7 is the design drawing of this detector-amplifier housing assembly.

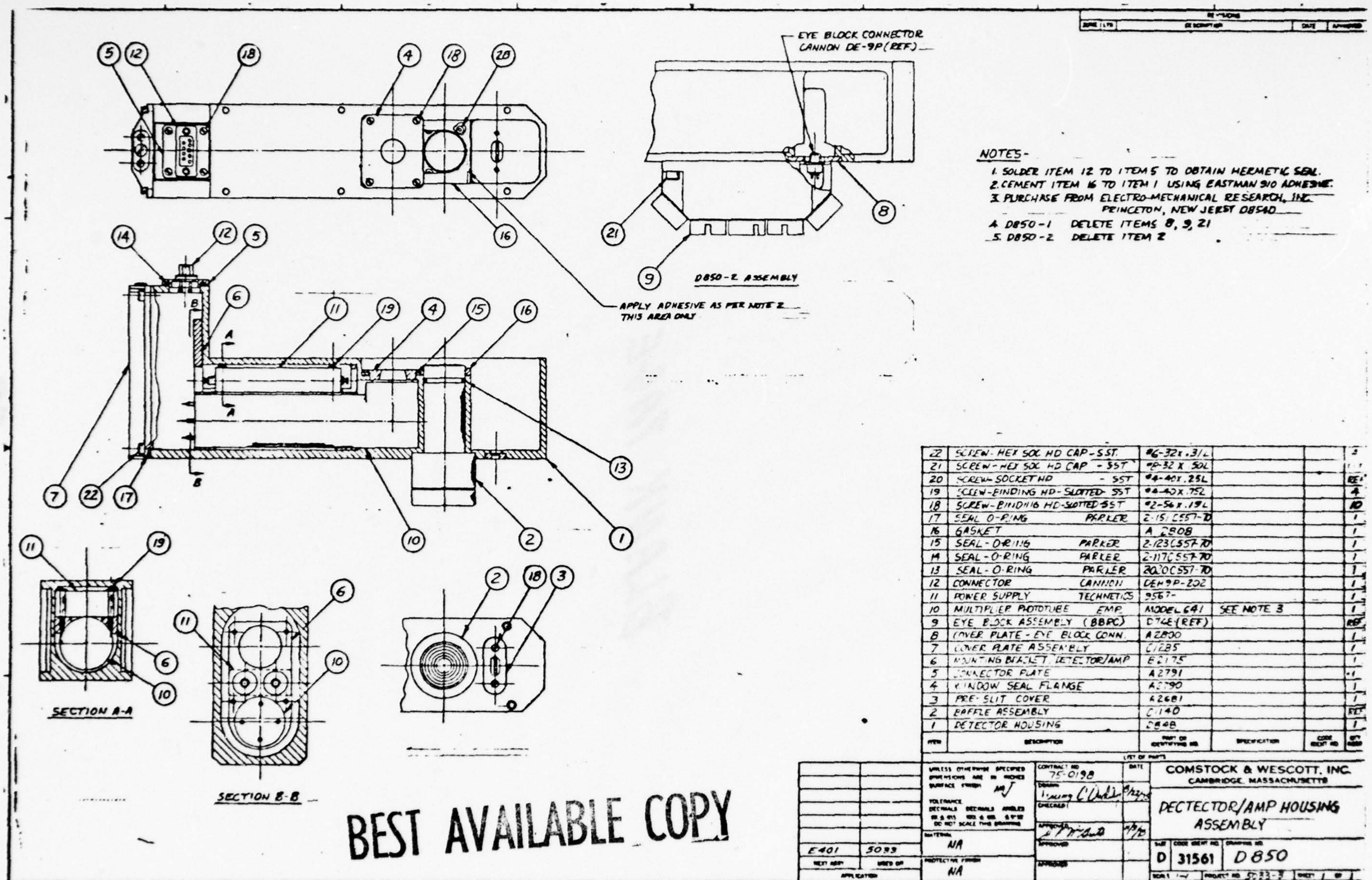


Figure 7. Detector/Amp Housing Assembly

3.2.9 Drive Assembly

The drive assembly was designed to provide wavelength scans incrementally proportional to incremental angular inputs from the drive motor. It consisted primarily of a main support housing, a Singer permanent magnet 45^{o} stepper with a gearhead, a drive screw, a nut driven drag link with socket for accepting the grating lever arm ball, mechanical stops, and a Litton Industries' absolute position encoder. The Singer permanent magnet stepper with gearhead replaced the Mesur-Matic High response motor when the latter was found incapable of providing uniform single step increments, thereby making line shape measurements impractical. Figure 8 illustrates the drive assembly.

3.2.9.1 Drive Screw

The drive screw was directly coupled to the reduction gearhead and was manufactured from type 303 stainles steel. It was accurately ground, nitrided, and lapped to the drive nut. It had a thread pitch of 0.5 mm which resulted in a linear motion of the drive nut of 12.303 x 10^{-6} inch per step of the motor.

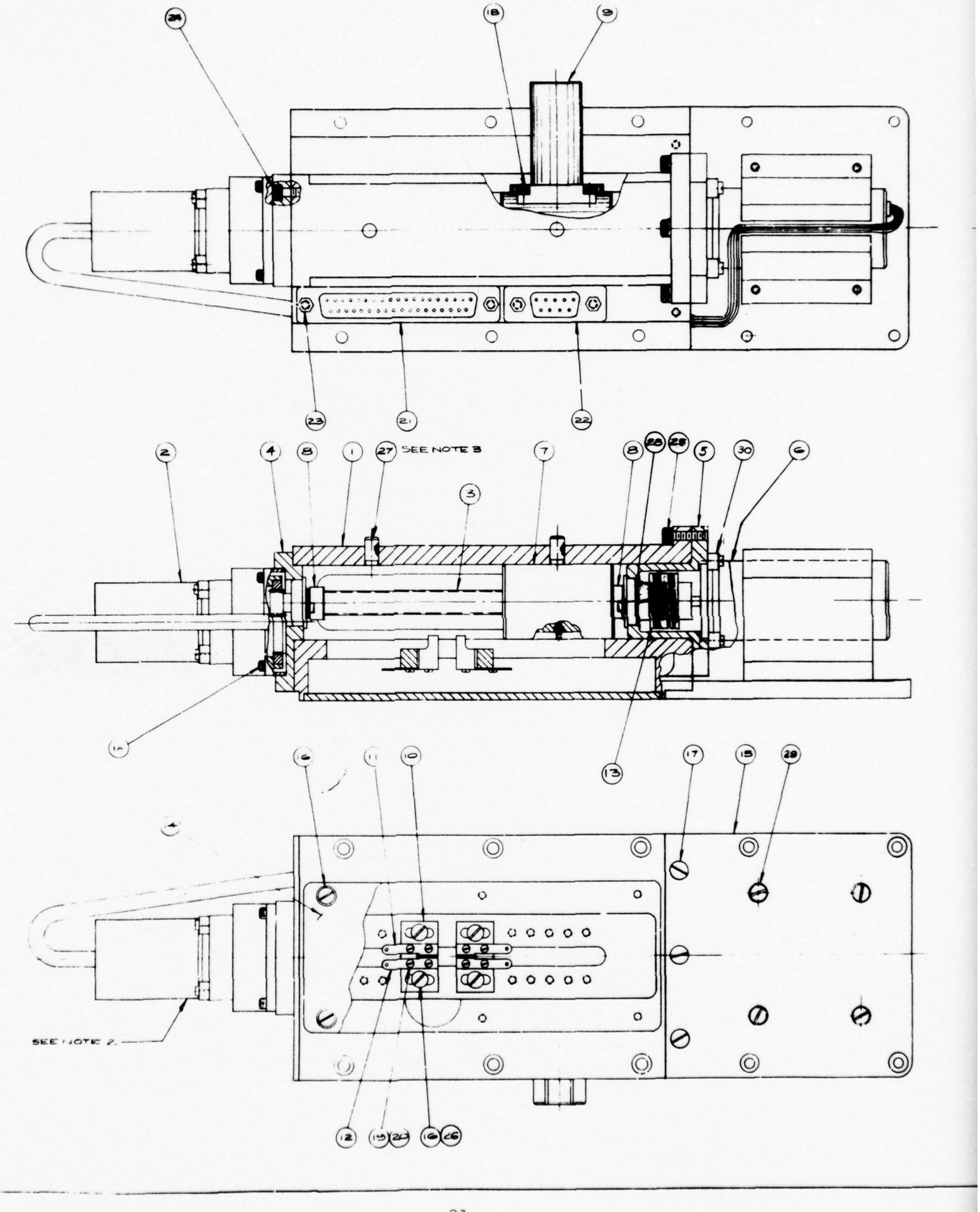
3.2.10 Background Filter Assembly

This assembly which was mounted near the exit slit utilized rotary solenoids as the activating motors to accomplish filter insertion into the exit beam for background measurements. The solenoids were engineered for long life with the use of ball bearings rather than sleeve bearings to enhance their reliability in the operational environment. This assembly is depicted in Figure 9.

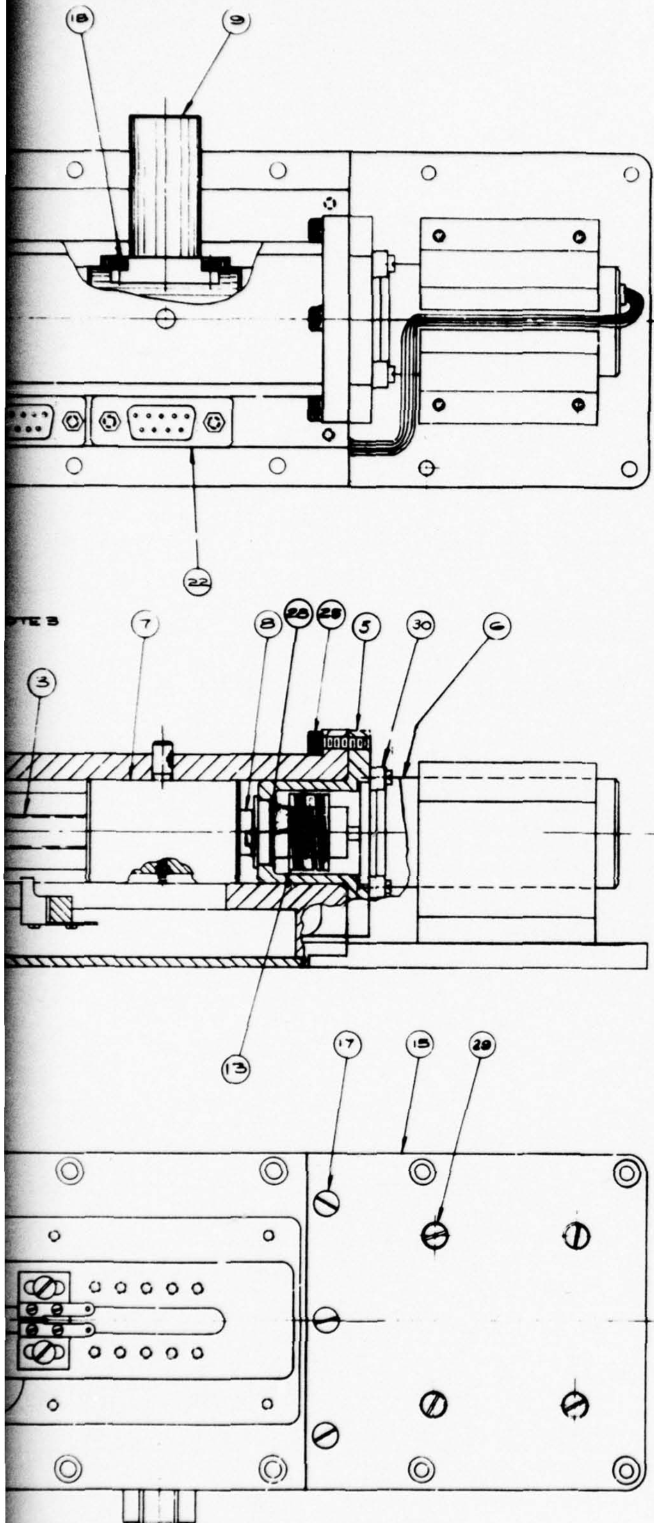
In the top deck a Corning No. 7056 filter was inserted at 1860Å and 2340Å. The bottom deck utilized a sapphire window with insertions at 1379Å and 1759Å. In both assemblies the motor would stop for one second at the selected wavelength, accumulate the background count and then continue scanning in the same direction.

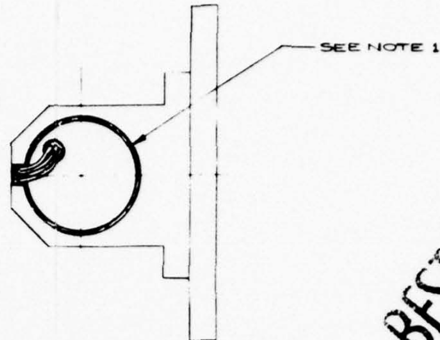
3.2.11 Range Change Filter Assembly

An assembly was designed to insert one or two neutral density filters in front of the entrance slit of the long wavelength scanning spectrometer (top deck) to attenuate the incoming radiation. It utilized a push type linear solenoid in order to decrease the mass of the armature and eliminate the extra link necessary with a pull type solenoid. The arms were supported on Bendix flex pivots that permitted frictionless oscillatory motion and provided for the spring return force to the de-energized solenoid position. See Figure 10.



SEE NOTE 3
SEE NOTE 2.





NOTES -
1. THERMALLY BOND MOTOR COVER (ITEM 15) TO MOTOR HOUSING WITH ECCOSIL 4852 RTV THERMALLY CONDUCTIVE ELASTOMER.
2. ADJUST ENCODER READING BY RELEASING CLEAT CLAMPING PRESSURE & ROTATING ENCODER HOUSING.
3. PRESS FIT DOWEL PINS (ITEM 27) INTO HOUSING, ALLOW TO PROJECT .12 INCH.

30	MOUNTING CLEAT.	L3-23	PIC	4
29	SCREW, BINDING HD, SLOTTED	4-40 x .38 LG	SST	4
28	SHIM .250 ID X .3750D X .004		PIC# B8-1	1
27	DOWEL PIN	.1877 X .38	PIC# D19-375	2
26	FLAT WASHER	#4		4
25	SCREW, SOC HD CAP	#6-32 X .44L		5
24	SCREW SOC HD CAP	#4-40 X .38L	SST	4
23	SCREW LOCK ASSY	D20418-2	ITT CANNON	4
22	CONNECTOR	DEM-9P	ITT CANNON	1
21	CONNECTOR	DCM-37P	ITT CANNON	1
20	INSULATOR NUT	A2743		8
19	SCREW, MINATURE BINDER HD	[illegible]	SST	4
18	SCREW, SOC. HD. CAP	2-56 X 1/4 LG	SST	4
17	SCREW, FLAT HD. SLOTTED	4-40 X .38 LG	SST	5
16	SCREW, BINDING HD, SLOTTED	4-40 X .25 LG	SST	10
15	MOTOR COVER	B2186		1
14	DRIVE HOUSING COVER	A2796		1
13	COUPLING, SHAFT	4082-88	HELICAL PROD	1
12	TERMINAL CONTACT	B2021		2
11	TERMINAL CONTACT	B2082		2
10	TERMINAL BLOCK	B2022		2
9	BALL SOCKET	B2183		1
8	STOP NUT	A2795		2
7	DRIVE NUT ASSY	B2203		1
6	MOTOR/GEARHEAD ASSY	AS SPECIFIED		1
5	MOTOR MNTG FLANGE	A2827		1
4	ENCODER MNTG FLANGE	B2180		1
3	DRIVE SCREW ASSY	B2202		1
2	GEARHEAD/ENCODER ASSY	C1280		1
1	DRIVE HOUSING	C1282		1

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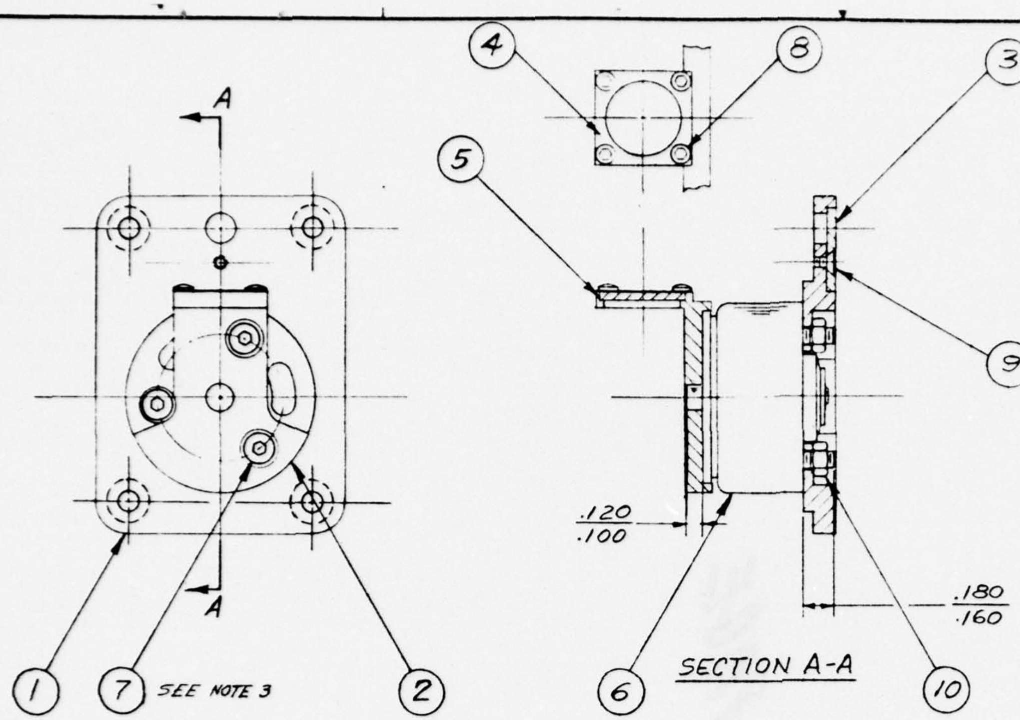
DRIVE ASSEMBLY

E401 5033

E399

5033-8

Figure 8. Drive Assembly



ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

NOTES-

1. CUT OFF ARMATURE SHAFT ON ITEM 6 TO DIMENSION SHOWN.
2. CUT OFF TWO #3-48 MOUNTING STUDS ON ITEM 6 TO DIMENSION SHOWN.
3. CHECK FOR SCREW INTERFERENCE WITH STROKE.
4. ASSEMBLE 6 WITH 1 FOR RIGHT OR LEFT OPERATION AS REQ'D.
5. VIEW SHOWS BOTTOM DECK ASSY CONFIGURATION IN THE ENERGIZED POSITION.

LIST OF PARTS

ITEM	DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	CODE IDENT NO.	Q RE
10	HEX NUT	#3-48UNC-2B	SST		2
9	SCREW-FLAT HD SLOTTED	#0-80UNFX.12L	SST		1
8	SCREW-BINDER HD.	#0-80UNFX.09L	SST		[illegible]
7	SCREW-BINDER HD.	#3-48UNCX.15L	SST		[illegible]
6	ROTARY SOLENOID	129709-034	LEDEX INC.		1
5	FILTER		AS SPECIFIED		1
4	FILTER RETAINER	A 2805			1
3	COVER-TEST HOLE	A 2806			[illegible]
2	FILTER ROTOR	B 2195			[illegible]
1	SUPPORT COVER-FILTER SOLENOID	B 2194			1

NEXT ASSY	USED ON
E401	5033

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
SURFACE FINISH √
TOLERANCE: DECIMALS XX ± .015 DECIMALS XXX ± .005 ANGLES ± 0°15'
DO NOT SCALE THIS DRAWING
MATERIAL
PROTECTIVE FINISH

CONTRACT NO. 75-0193
DRAWN Henry C Dudley 11/3/75
CHECKED
APPROVED J F McGrath 11/9/75
APPROVED
APPROVED

COMSTOCK & WESCOTT, INC.
CAMBRIDGE, MASSACHUSETTS

BACKGROUND FILTER ASSEMBLY

SIZE C | CODE IDENT NO. 31561 | DRAWING NO. C1287
SCALE 2X | PROJECT NO. 5033-7 | SHEET 1 OF 1

BEST AVAILABLE COPY

Figure 9. Background Filter Assembly

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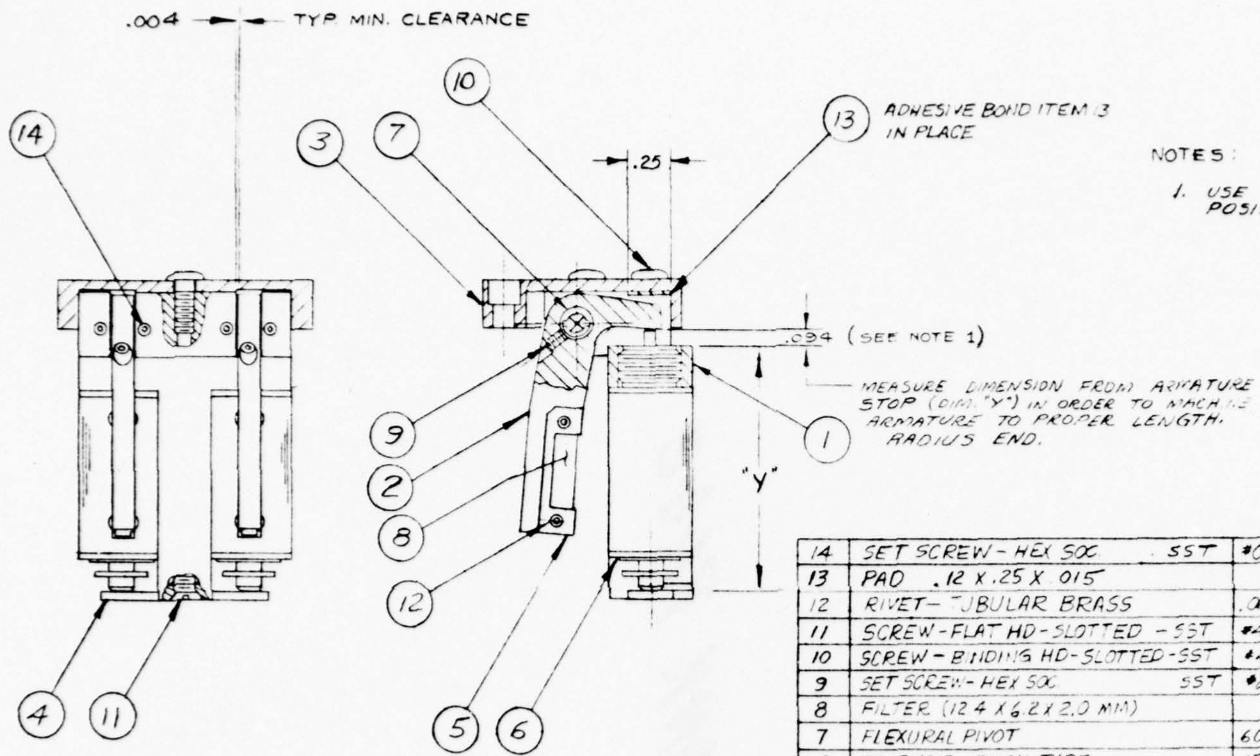

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADDED ASSY DIMENSIONS	12/21/76	JMD

NOTES:

1. USE .042/.048 WHEN SETTING NULL POSITION OF FLEX-PIVOT.

ITEM	DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	CODE IDENT NO.	QTY REQ
14	SET SCREW - HEX SOC SST	#0-80 X .12L			4
13	PAD .12 X .25 X .015		CYCLIZED NAT RUBBER		2
12	RIVET - TUBULAR BRASS	.062 DIA X .12L			4
11	SCREW - FLAT HD - SLOTTED - SST	#4-40 X .25L			1
10	SCREW - BINDING HD - SLOTTED - SST	#4-40 X .25L			2
9	SET SCREW - HEX SOC SST	#2-56 X .12L			2
8	FILTER (12.4 X 6.2 X 2.0 MM)		MATERIAL AS SPEC.		2
7	FLEXURAL PIVOT	6006-800	BENDIX CORP		2
6	SOLENOID - PUSH TYPE	178763-035	LEDEX		2
5	FILTER BRACKET	A2824			2
4	ARMATURE STOP	A2822			1
3	SOLENOID HOUSING COVER	A2825			1
2	FILTER ARM	A2823			2
1	SOLENOID HOUSING	B2207			1

LIST OF PARTS

NEXT ASSY	E401
USED ON	5033
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
SURFACE FINISH NA
TOLERANCE: DECIMALS XX ± .015, DECIMALS XXX ± .005, ANGLES ± 0°15'
DO NOT SCALE THIS DRAWING
MATERIAL NA
PROTECTIVE FINISH NA

CONTRACT NO. 75-0198
DRAWN [signature] DATE 12/8/75
CHECKED
APPROVED [signature] 12/8/75
APPROVED
APPROVED

COMSTOCK & WESCOTT, INC.
CAMBRIDGE, MASSACHUSETTS

RANGE CHANGE FILTER ASSEMBLY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
C	31561	C1293	A

SCALE 2-1 PROJECT NO. 5033-7 SHEET 1 OF 1

BEST AVAILABLE COPY

Figure 10. Range Change Filter Assembly

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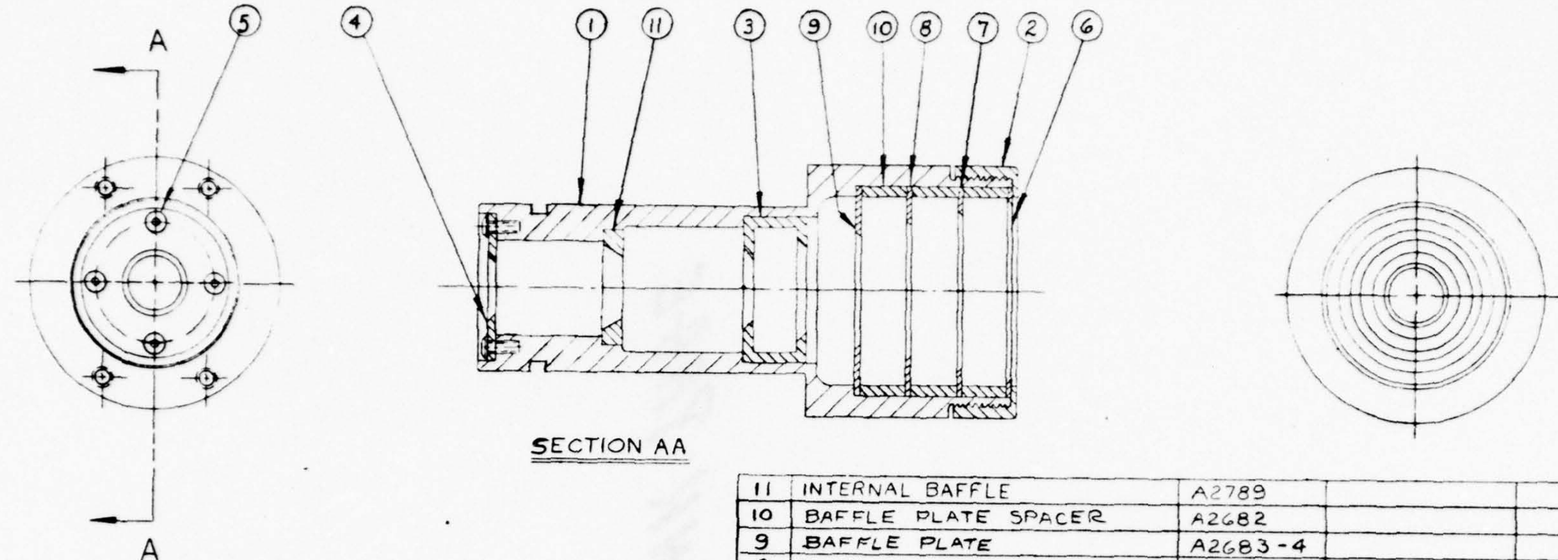
The filters supplied by Acton Research Corporation had a nominal transmission of ten percent. From 1700Å to 1799Å the incoming radiation was unattenuated; from 1800Å to 2499Å one of the filters was inserted in front of the entrance slit; from 2500Å to 3500Å the second filter was inserted behind the first one reducing the incoming radiation by a factor of about one hundred.

3.2.12 Solar Viewing Photometer

This photometer was a gas-filled ionization chamber operated in a unity gain mode purchased from Artech Corporation of Church Falls, Virginia. With the use of a sapphire window and para-xylene gas it encompassed the wavelength coverage from 1425Å to 1500Å with a peak spectral response at about 1455Å. A plot of ion current versus collection voltage was obtained at Comstock & Wescott and supplied to the AFGL scientists. Actual calibration of the ion chamber was carried out by AFGL personnel at their facility.

A double baffle was provided in front of the photometer to eliminate secondary reflections from the nose cone. This baffle assembly is illustrated in Figure 11.

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	ADDED (11), REVISED DIM. ON (1)	6/25/75	



ITEM	DESCRIPTION	PART OR IDENTIFYING NO.	SPECIFICATION	CODE IDENT NO.	QT REQ
11	INTERNAL BAFFLE	A2789			1
10	BAFFLE PLATE SPACER	A2682			3
9	BAFFLE PLATE	A2683-4			1
8	BAFFLE PLATE	A2683-3			1
7	BAFFLE PLATE	A2683-2			1
6	BAFFLE PLATE	A2683-1			1
5	MNTG SCREWS #1-72 SPLINE SKT. HD 1/8 LG.		300 S.S.		4
4	REAR APERTURE STOP	B2017			1
3	INTERMEDIATE BAFFLE RING	B2018			1
2	BAFFLE CLAMP RING	B2016			1
1	BAFFLE HOUSING	B2019-A			1

LIST OF PARTS

EST. WT.	.206 #
D 850-1	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
SURFACE FINISH √
TOLERANCE: DECIMALS XX ± .015 DECIMALS XXX ± .005 ANGLES ± 0° 15'
DO NOT SCALE THIS DRAWING
MATERIAL —
PROTECTIVE FINISH —

	DATE
CONTRACT NO. 72-0254	
DRAWN J. P. McGath	7/18/72
CHECKED	
APPROVED	
APPROVED	
APPROVED	

COMSTOCK & WESCOTT, INC.
CAMBRIDGE, MASSACHUSETTS

BAFFLE ASSEMBLY
TYPE II SPECTROMETER

SIZE	CODE IDENT NO	DRAWING NO	
C	31561	C 1140	A
SCALE 2X	PROJECT NO. 5030-5	SHEET	OF

Figure 11. Baffle Assembly Type II Spectrometer

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4. ELECTRONIC SUBSYSTEMS

4.1 General

The instrument contained two similar electronic subsystems, each being independent of the other, with its own power supply, detector assembly, electronics, and telemetry interface.

The current pulses from the photomultiplier were amplified and counted and the count converted to a binary coded decimal (BCD) number. The magnitude of the number was a function of radiation intensity.

4.2 Physical Configuration

The electronic system was made up of three sections:

1. The pulse amplifiers and high voltage supplies in the detector assemblies.

2. Twelve printed circuit cards located in a card rack, integral with the rear of the housing (five cards for each deck plus photometer electronics and commutator).

3. Five more larger circuit cards in another card rack near the center of the instrument (2½ cards for each deck).

A dual (+14V, -14V) low voltage regulated power supply was mounted on one card of each deck. Hence, all electronics were internal to the housing and shielded from

receiving or producing external radio frequency interference. The card rack was also shielded from the detectors and vented directly to the outside of the housing away from the instrument entrance aperture.

Each photomultiplier was contained in a pressurized assembly along with its pulse amplifier, high voltage power supply and filter. Thus, the instrument could be operated at any ambient pressure.

4.3 Wavelength Drive Operation

The electronics controlled the stepping motor and generated a BCD number representing the number of steps that the scan motor had taken since being reset to zero at the short wavelength end of the scan. Since the motor advanced 40 steps to move the scan one Angstrom, the short wavelength (bottom) deck required 20,000 steps to scan from 1300Å to 1800Å; the top deck required 72,000 steps to scan from 1700Å to 3500Å.

The PCM frame rate was the same as the scan stepping rate and was synchronized with it, so that the scanner moved to the next position at the beginning of the PCM frame.

The bottom deck was scanned in wavelength at the rate of 100 steps per second or 2.5Å per second thus requiring 200 seconds to scan from 1300Å to 1800Å. The current pulses (each pulse representing one photoelectron leaving the photomultiplier cathode) were counted for the step duration of 0.01 seconds. Thus, the count rate which filled the 16 bit shift register (4 decimal digits) was 100 times 9999 plus 1 or 1 MHz.

The top deck was scanned at the rate of 300 steps per second or 7.5Å per second thus requiring 240 seconds to scan from 1700Å to 3500Å. The count rate which filled the top deck shift register was 300 times 9999 plus 1 or 3 MHz.

The sensitivity of the instrument was intentionally limited such that flight data rates did not exceed 0.2 MHz. Flight data were random and the pulse amplifier would have compressed the count rate excessively if a random rate above that value had been encountered; therefore, the register capacities were more than adequate. Both decks could also be operated at a 5 step per second scan rate for calibration. In this mode the photon count rate which filled the count register was 50,000 counts per second. An extra factor of two was also available from bit 12 of the PCM waveform if required.

An absolute encoder was incorporated into each scan system and its output was processed by the electronics to present a binary coded decimal number representing the wavelength in Angstroms.

The end of scan wavelengths for each deck was sensed from the respective absolute encoder and the signal used to activate the scan reversal circuits. Limit switches were installed on the scan drive assemblies as a backup to prevent jamming the drive against the end of travel if the encoders became inoperative.

The readout of the absolute encoder also activated a solenoid which inserted a background filter in the photon beam when the instrument was scanning down only at 1379Å

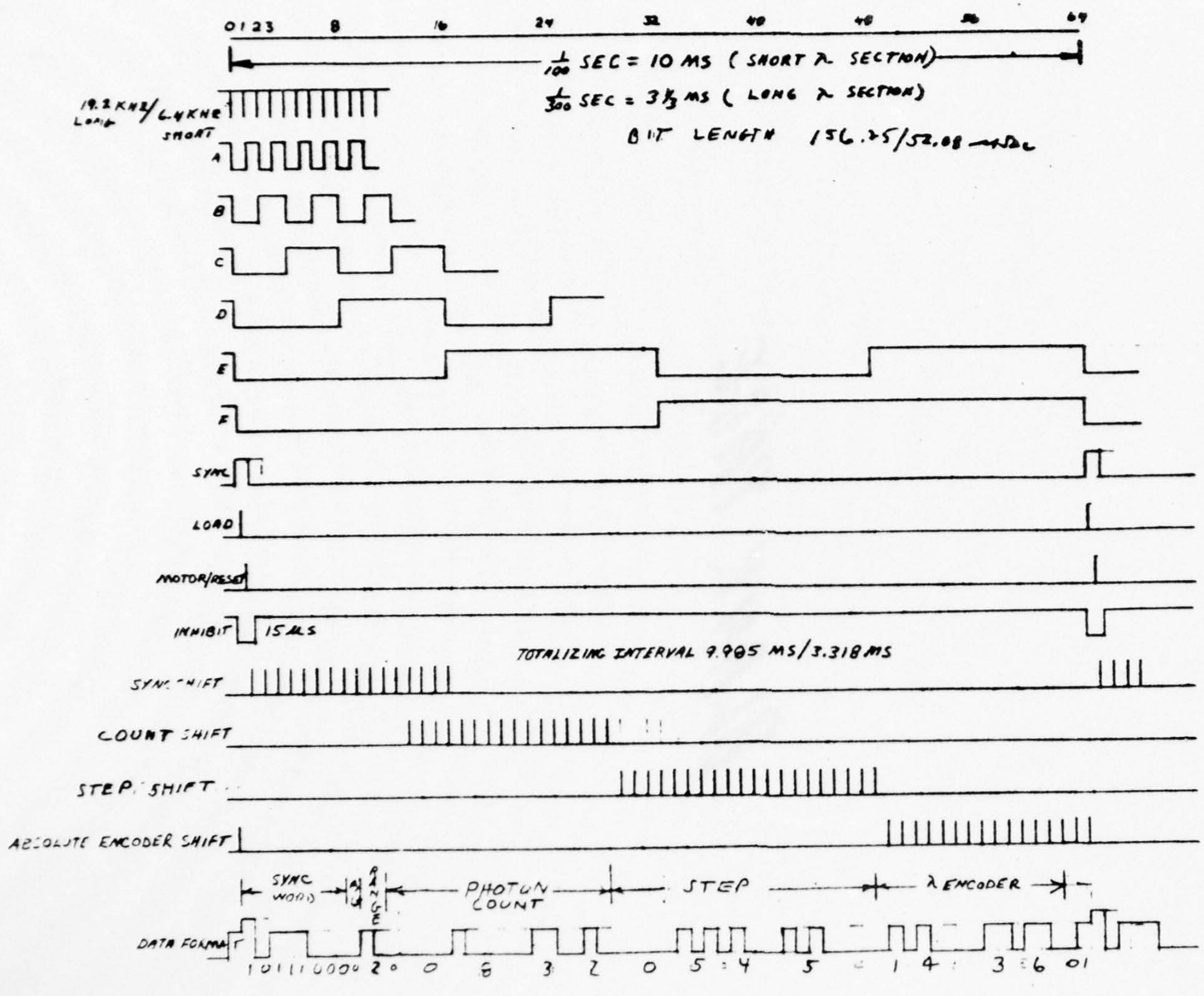
and 1759Å on the bottom deck and scanning up only at 1860Å and 2340Å on the top deck. The filter stayed in the beam for approximately one second and during this time, the scan was stopped. Bit 9 of the PCM frame changed from a 0 to 1 while the filter was inserted.

The top deck detector assembly had two neutral density filters which were inserted in the beam to reduce the instrument's input. The first filter was inserted at wavelengths above 1800Å and a second filter was also inserted at wavelengths above 2500Å. The position of the filters was indicated by bits 10 and 11 of the PCM frame. The range readout on the console indicated range 1 for no filter inserted, range 2 for one filter and range 3 for both filters.

4.4 PCM Data Format

The PCM frame was made up of an eight-bit sync word, three bits for background and range filters, seventeen bits for photon count, twenty bits for motor steps, and fourteen bits for absolute encoder readout, leaving two non-changing spare bits at the end of the sixty-four bit frame. A timing diagram of the PCM data format and logic waveform is given in Figure 12. Note that the first bit of the PCM data was of greater amplitude than the remaining bits. This permitted the start of each frame to be detected by amplitude discrimination, in lieu of digital techniques requiring comparison of 8 bits.

Thus, the ground support equipment was greatly simplified. It worked reliably on clear strong signals present in the laboratory and prior to launch. The digital sync word was used by the computer for reducing actual flight data.



RS 62

TIMING DIAGRAM

B 920

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Figure 12. RS 62 Timing Diagram

4.5 Electrometer-Amplifier

The instrument electronics also contained an electrometer amplifier to energize the photometer diode and process its output for telemetry. The diode case was connected to ground and its center wire to -6 volts. Thus, ions were collected and the output voltage of the amplifier went more negative for increasing ion current.

The system had four linear ranges which had full scale sensitivities of 5×10^{-12}, 5×10^{-11}, 5×10^{-10}, and 5×10^{-9} amperes, respectively. The correct range was automatically selected. The output to telemetry was 5 volts for no signal and 0 volts for full scale. Thus, a reading of 3.0 volts on the most sensitive range indicated a current of 2.0×10^{-12} amperes. The range used was indicated by a separate signal of 0 volts for the most sensitive range, 1.7 volts for 10^{-11} ampere range, 3.4 volts for the 10^{-10} ampere range, and 5 volts for the 10^{-9} ampere range.

4.6 Commutator

A 16 segment commutator was included in the electronic system. It had a high impedance input and a low output impedance to drive telemetry and monitor meters. The segments were assigned as follows:

1,2	0 V
3	2.5 V
4,5	5.0 V
6	Top HiV Mon.
7	Bottom HiV Mon.
8	Temp. (forward)
9	Temp. (middle)

10	Temp. (rear)
11	---
12	Battery
13	Elec. Spec. HiV Mon.
14	---
15	Photo HiV Mon.
16	---

There were three temperature monitors on the housing; one at each end and one near the center. The thermistor sensors were connected to three amplifiers on the commutator card.

4.7 Circuit Description

A block diagram of the instrument electronics is given in Figure 13.

A detector amplifier was used to feed pulses to a photon counter consisting of four decade counters. The binary-coded-decimal output from the counters, representing the number of photons collected by the detector in 3.3 or 10 milliseconds (one PCM frame time or step time of the wavelength scanner) was transferred to the 16 bit shift register and shifted out to the PCM output line during the following frame. See Figures 14 and 15.

The wavelength-scanner position was counted in five decade counters on the motor logic readout cards, transferred to a 20 bit shift register, and shifted out after the photon data. See Figure 16.

The logic circuits for driving the four position stepping motor were included with the step counting circuit on the motor logic card. The motor drive circuits were on separate cards in the center card rack. See Figure 17.

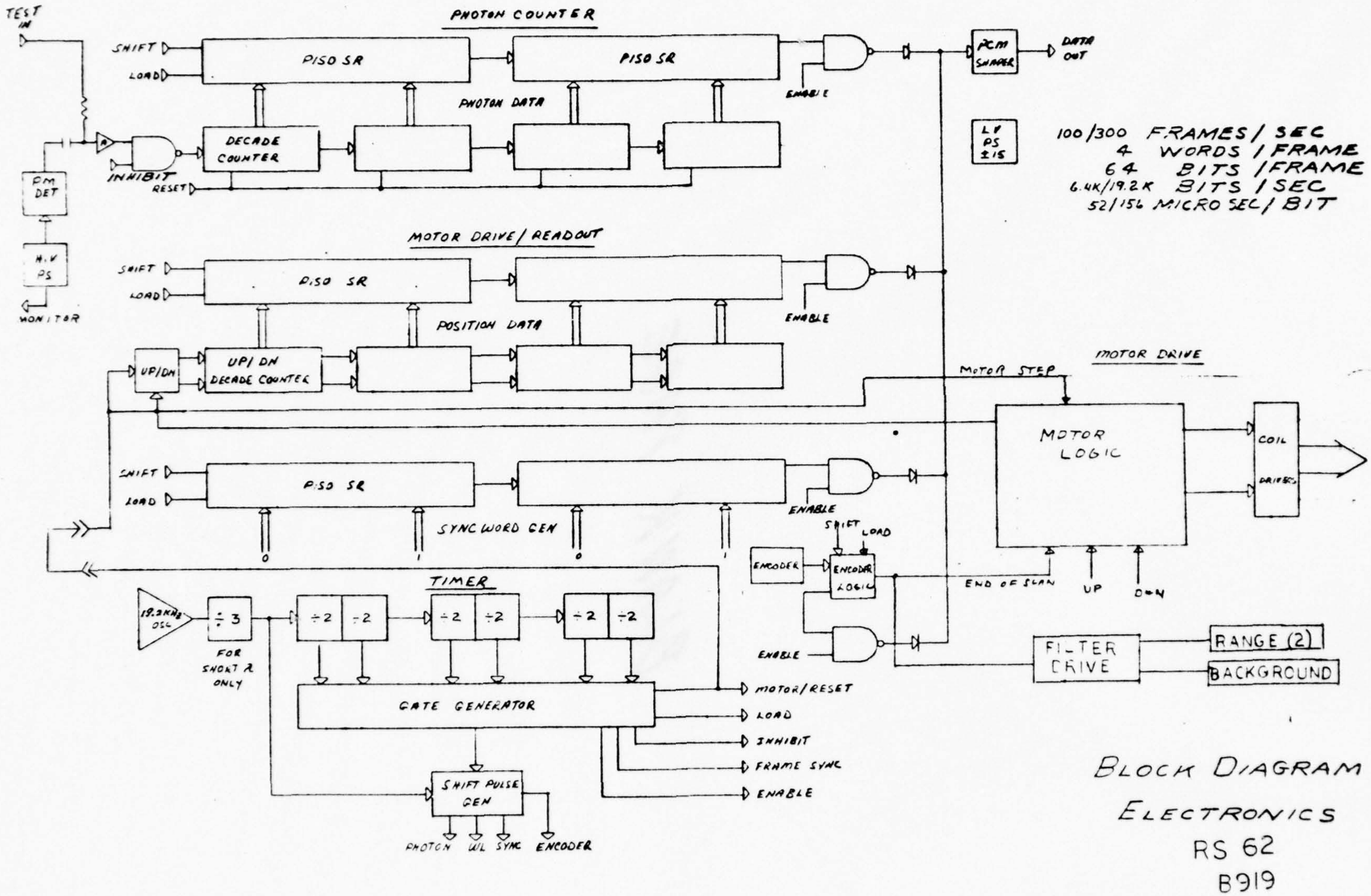

Figure 13. RS 62 Block Diagram Electronics

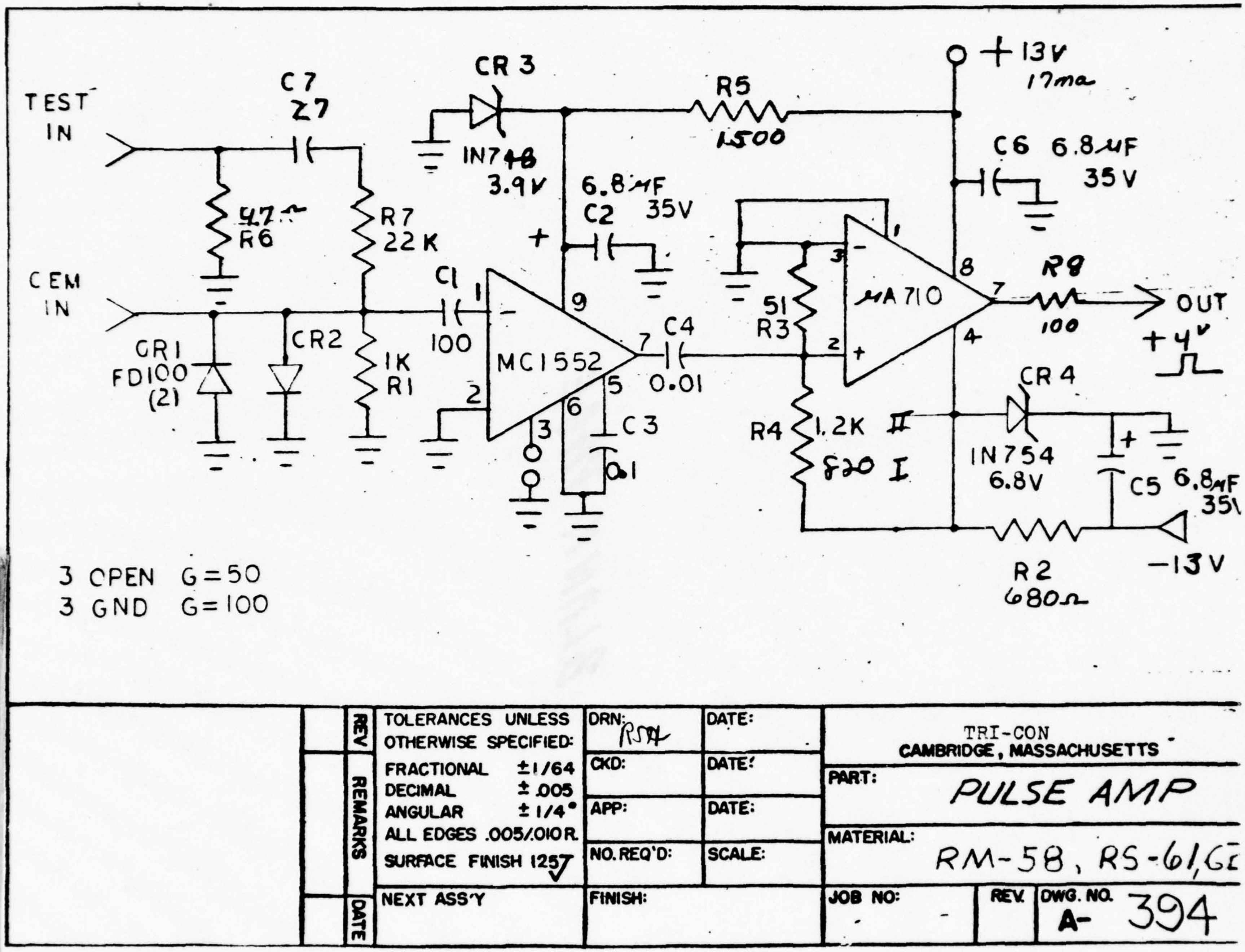

Figure 14. Pulse Amp

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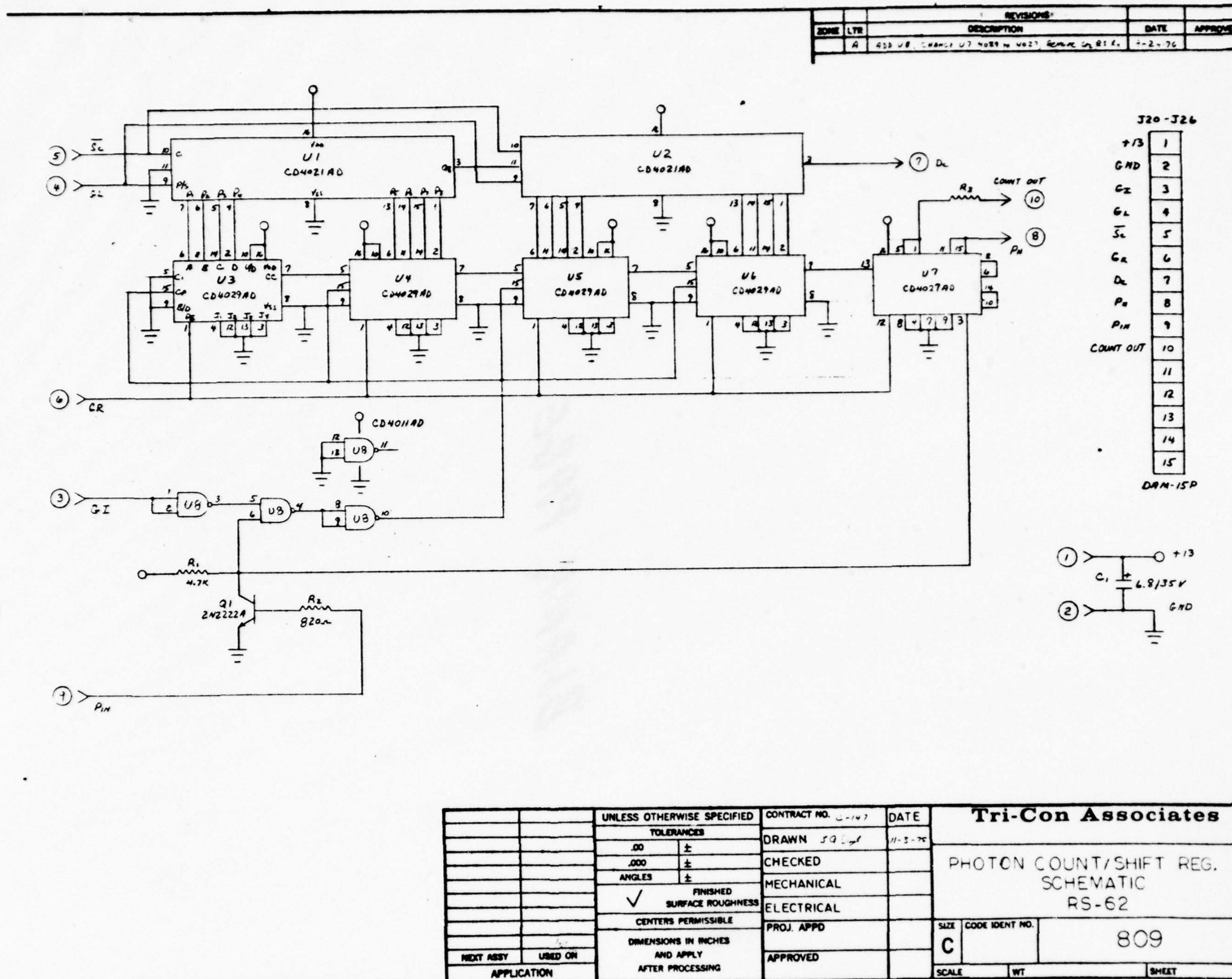

Figure 15. Count/Shift Reg. Schematic RS-62

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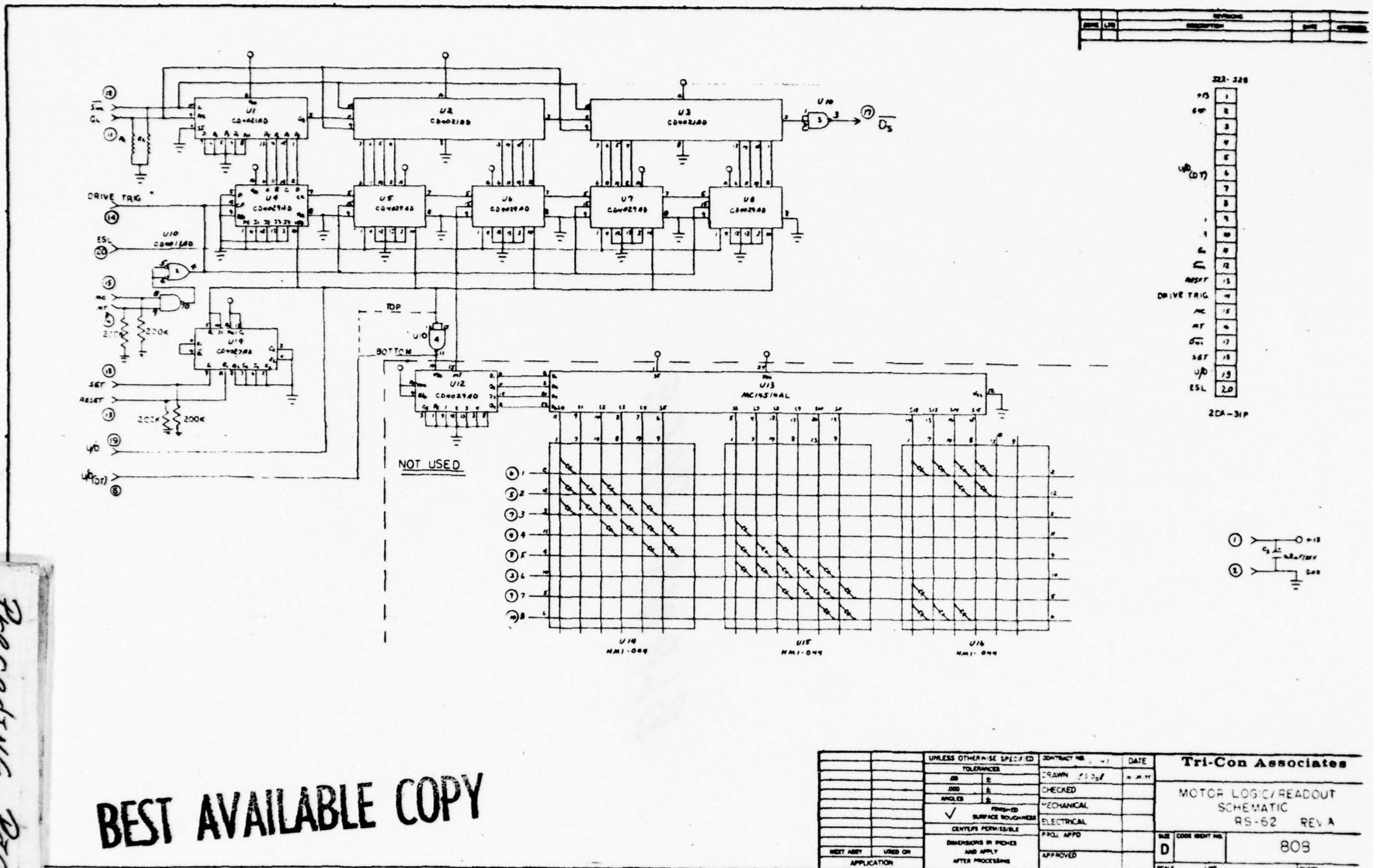

Figure 16. Motor Logic/Readout Schematic RS-62 Rev. A

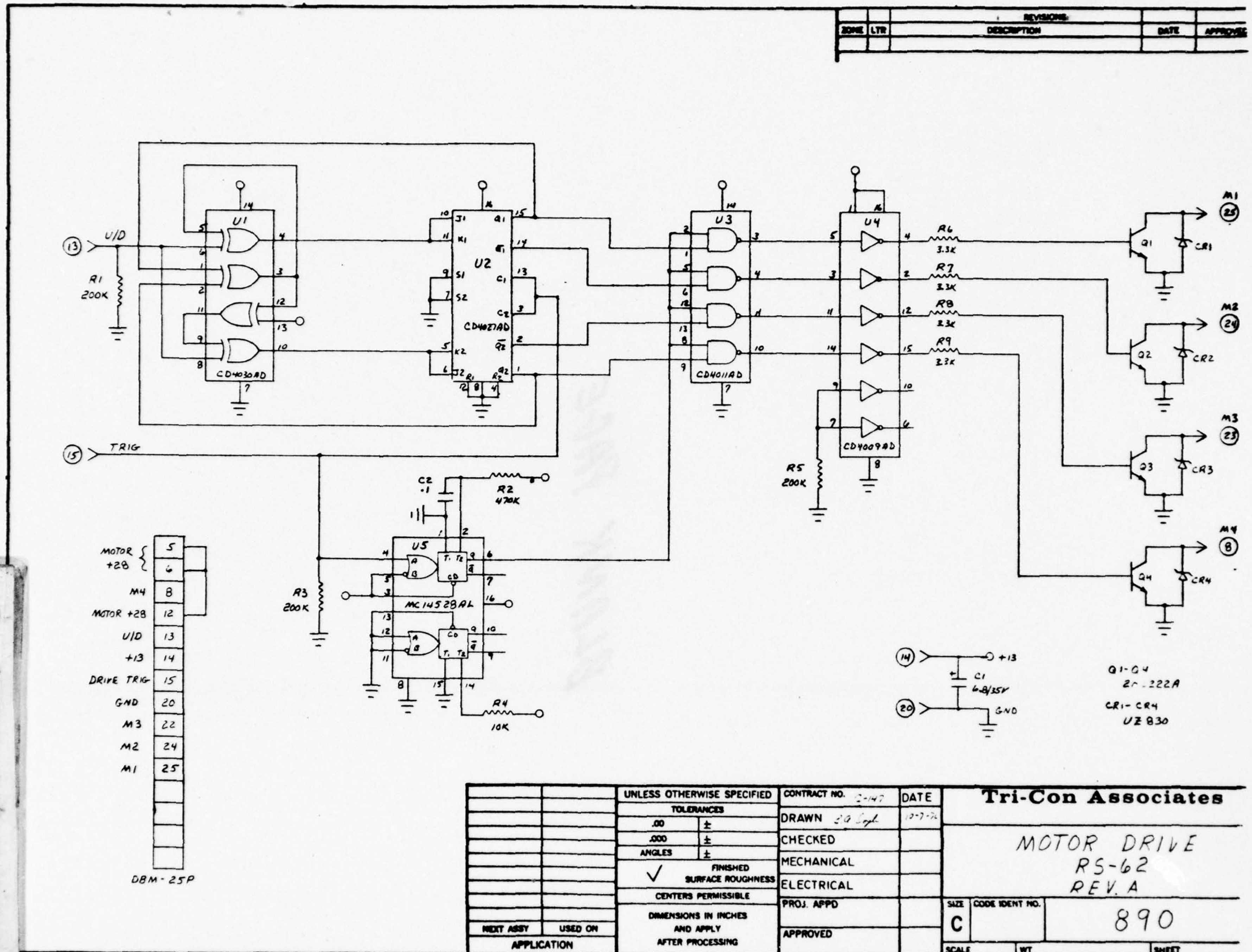

Figure 17. Motor Drive RS-62 Rev. A

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The outputs of the absolute encoders (a "V" scan system involving 30 connections to each encoder) were processed on the large encoder logic cards. See Figures 18 and 19. The logic to detect the correct wavelengths to energize the filters was also included on these cards. The filter drive circuits for both decks were on the same card in the center card rack.

The sync word 10111000 was generated on the timer card and was shifted out at the beginning of the PCM frame. See Figure 20.

The power supply/output card contained a DC to DC regulated-converter to supply plus and minus 14 volts from the 28 V flight battery or console power supply. It also had the telemetry interface buffer circuit and generated the load, reset and inhibit pulses. The load and reset signals occurred at 5 microseconds and 10 microseconds after the beginning of each frame. The photon counter was inhibited for 15 microseconds out of the total frame time. Thus, the actual accumulate time was 3.318 milliseconds on the top deck and 9.985 milliseconds on the bottom deck.

A test card contained a 1 MHz crystal oscillator which was used to provide a pulse to check the operation of the pulse amplifier and counters. The 1 MHz rate was used directly or divided by 100 to give a 10 KHz rate. The rate was selected by a console control but was 1 MHz if the console were not connected to the test connector.

The test card also contained a 19.2 KHz crystal oscillator which was the time base for generating all the system logic. When the card was used in the bottom deck, the

frequency was divided by 3 to give the correct time base. The frequency was also divided by an additional factor of 20 to provide a frame rate of 5 frames/second by means of a console control. The crystal oscillator was accurate to .01 percent in frequency.

The timer cards of both decks were similar, the bottom deck card having an extra divide by 3 circuit to provide the slower clock rate for that deck. Both cards could be run at 5 frames per second for calibration as mentioned above.

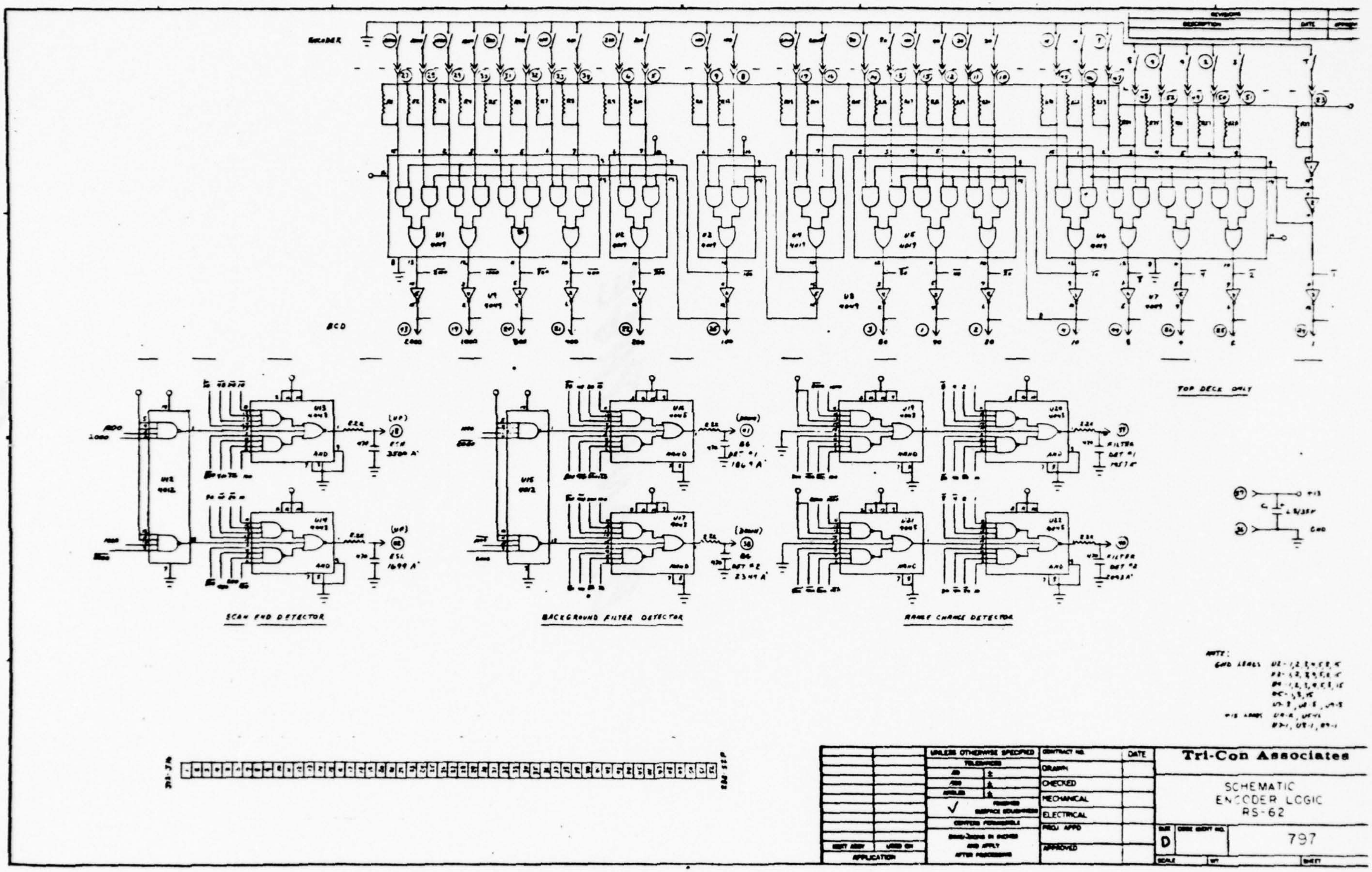

Figure 18. Schematic Encoder Logic RS-62

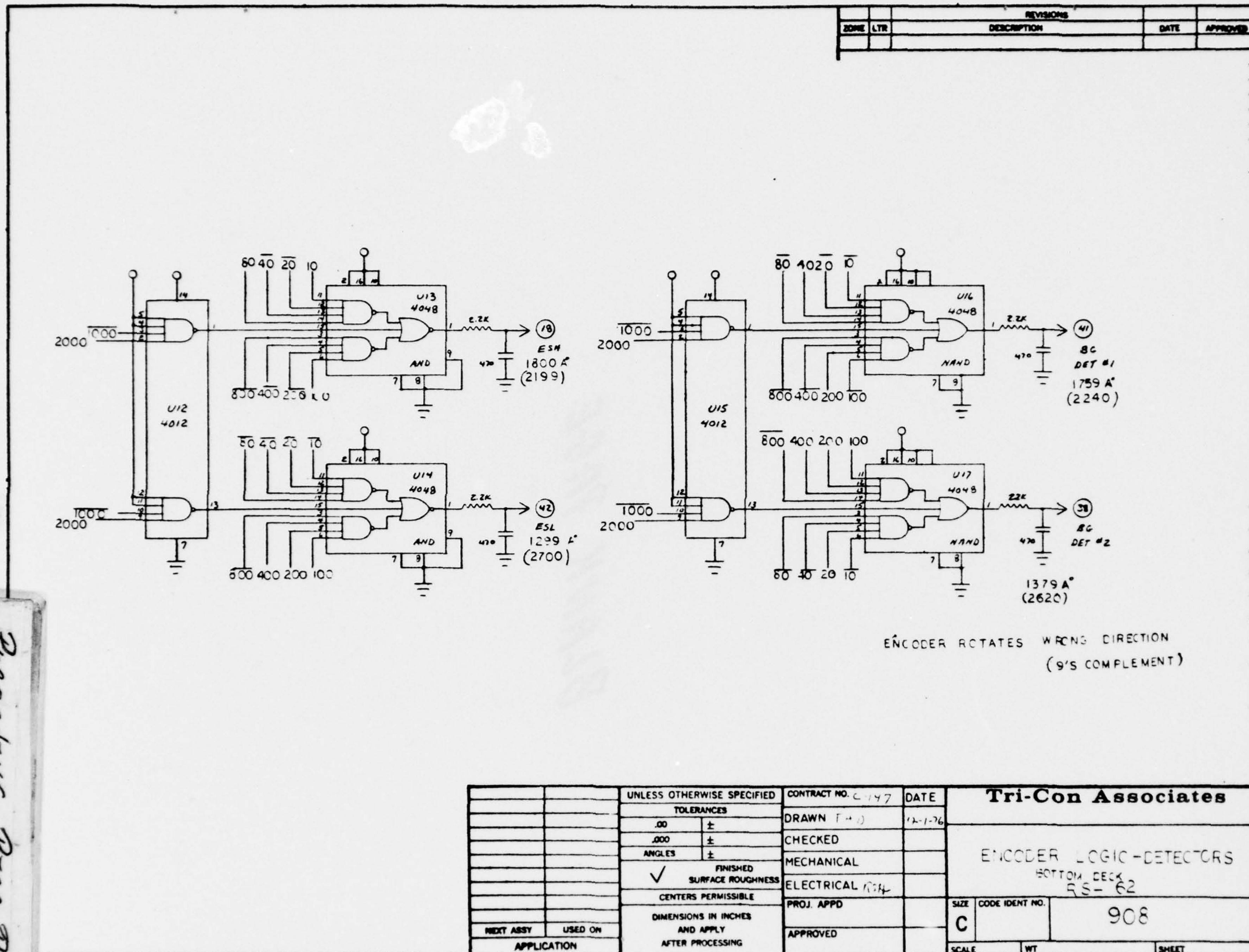

Figure 19. Encoder Logic-Detectors (Bottom Deck) RS-62

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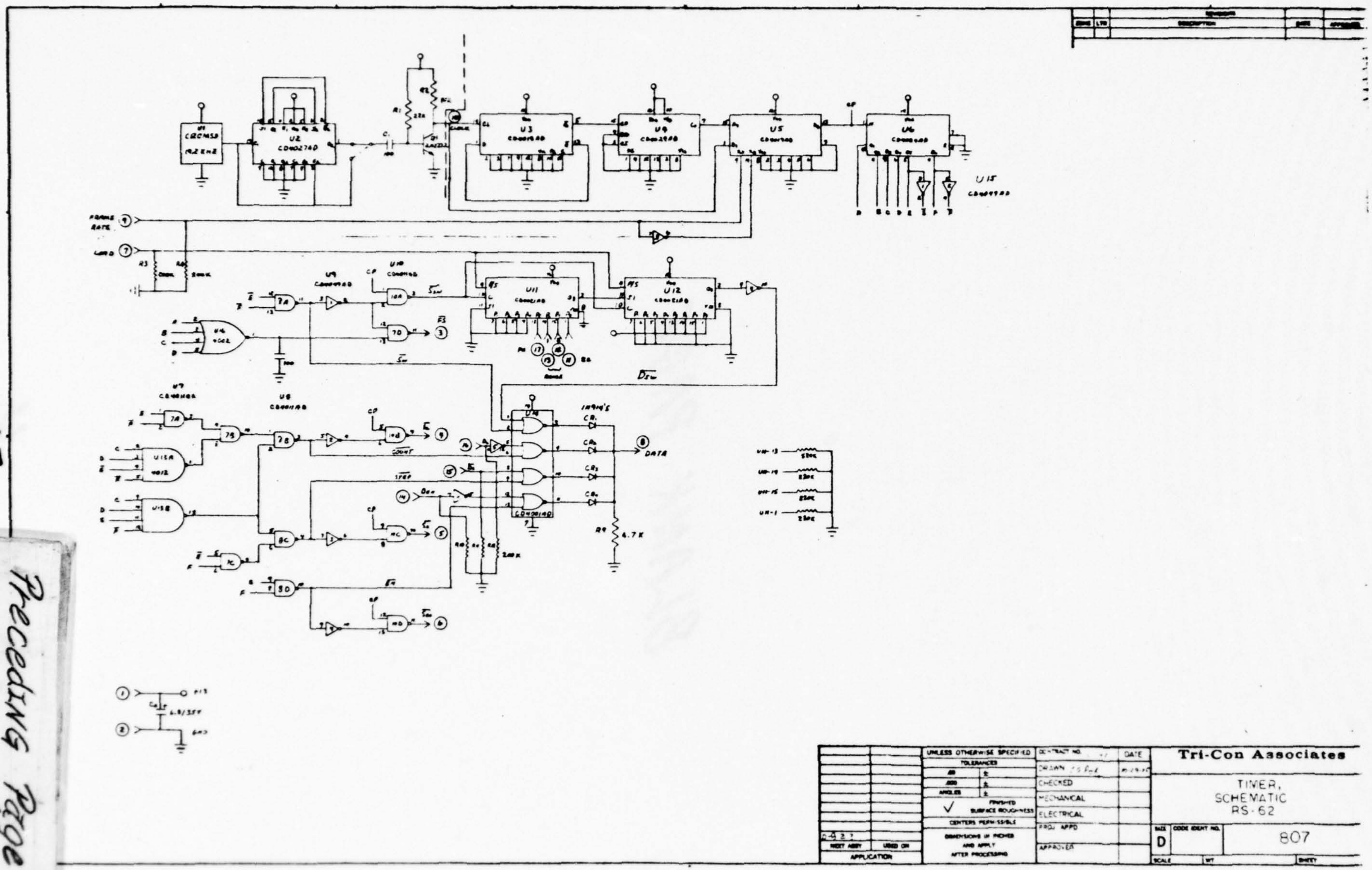

Figure 20. Timer, Schematic RS-62

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5. GROUND SUPPORT EQUIPMENT

5.1 General Discussion

A GSE console was designed and built for use with the RS-62 instrument. It was used to operate the two spectrometers during acceptance and environmental tests, calibration, integration, and in the field prior to launch. The console was also used to decode PCM photon count and wavelength data from both real time TM signals and flight magnetic tapes for quick look data reduction.

The panel was an "inverted pan" configuration which allowed cable connectors to be located on the sides. The raised panel had room below it for electronics and power supplies. Patch cables were carried inside the cover. The case dimensions were 33 cm by 46 cm by 18 cm high. The weight was 11.5 Kg.

Four power supplies were mounted to the bottom of the case. One of these supplied 28-volt power to the instrument with separate control of both low voltage and high voltage.

A blower drew in air through the bottom of the case to cool the power supplies and electronics since the case dissipated about 50 watts.

The electronics were contained on six printed circuit cards in a card rack fastened to the underside of the panel.

5.2 Readouts/Controls/Operation

For bench operation and calibration, the console was connected to the instrument by the test harness. In this configuration, power was supplied to the instrument from the console 28-volt supply, was controlled by the low voltage (LV) and high voltage (HV) switches, and monitored by the front panel meters. The PCM data from the instrument were decoded by the electronics in the console.

The console decoded data from either the top or bottom deck as selected by the DECK switch which also matched the console clock to the deck frame rate.

Sixteen of the seventeen bits of photon count data were decoded and displayed as 4 decimal digits labeled PCM COUNT. The position of the range changing filters was indicated by a 1, 2, or 3 appearing after the PCM COUNT.

With the wavelength switch on STEP, the motor step data of 20 bits were decoded and displayed as 5 decimal digits.

With the wavelength switch on Å, the wavelength in Angstroms was displayed as 4 decimal digits.

Since the encoder in the bottom deck of the instrument rotated to indicate decreasing wavelength when the scanner was increasing wavelength, the console circuits corrected the decoded data to give the correct Angstrom reading when the console was used with the bottom deck of the instrument.

With the FRAME RATE switch on SLOW the instrument (and console) operated at 5 frames per second and drove a Franklin printer as an aid in calibration.

The three most significant digits of the PCM count were converted to an analog voltage between 0 and 10 volts and this voltage was available at the BNC connector so labeled. The three least significant digits were also converted and the analog voltage was available at the other BNC connector.

The test oscillator of each deck was controlled by its own console switch. The AMP knob controlled the amplitude of both decks' pulses.

The monitor voltmeter read the console 28-volt power supply when on MONITOR position 1. Position 2 displayed the commutator output. Position 3 displayed the rocket flight battery voltage (÷10). Position 4 displayed the photometer output voltage and position 5 indicated the photometer range. The meter was buffered by an operational amplifier and did not load the circuit to which it was connected. Monitor voltages were available at the test jack above the MONITOR switch.

In order to sample and decode the PCM signal, the console clock had to be synchronized both in phase and frequency with the PCM frame. The sync control adjusted the amplitude of the PCM data signal to match the frame-sync detector threshold. Improper adjustment was indicated by the SYNC LOST lamp. When the lamp was off, the console clock was locked in phase with the PCM data frame at the start of each frame. The frequency of the

console clock was adjusted to match the PCM bit rate by the FREQUENCY control. Proper adjustment was achieved when the Angstrom readout was displaying a "clear" number, with all segments illuminated.

To assist in calibration, the console contained a 6-digit decade scaler which recorded the frequency of the square wave output of the instrument. The count accumulated in either 1 or 10 seconds, as selected by the TIME BASE switch, was displayed on the readout labeled PHOTON COUNT. The lamp to the right of the display indicated when the counter gate was open. The display time was two seconds in both the 1 second and 10 second count modes.

The SCAN CONTROL switches on the console panel gave individual control of the wavelength scan of each deck.

The SQUARE WAVE BNC connector provided a buffered output square wave signal that could be counted by an external counter if desired. The time base for the 1 second and 10 second counting intervals was derived from the console clock which was synchronized with the instrument crystal clock and accurate to ±.01 percent.

5.3 Technical Description

A block diagram of the console is given in Figure 21. A timing diagram is given in Figure 22. The logic was contained on six printed circuit cards designated timer, data decode photon, data decode wavelength, time base, and printer drive and Wang drive.

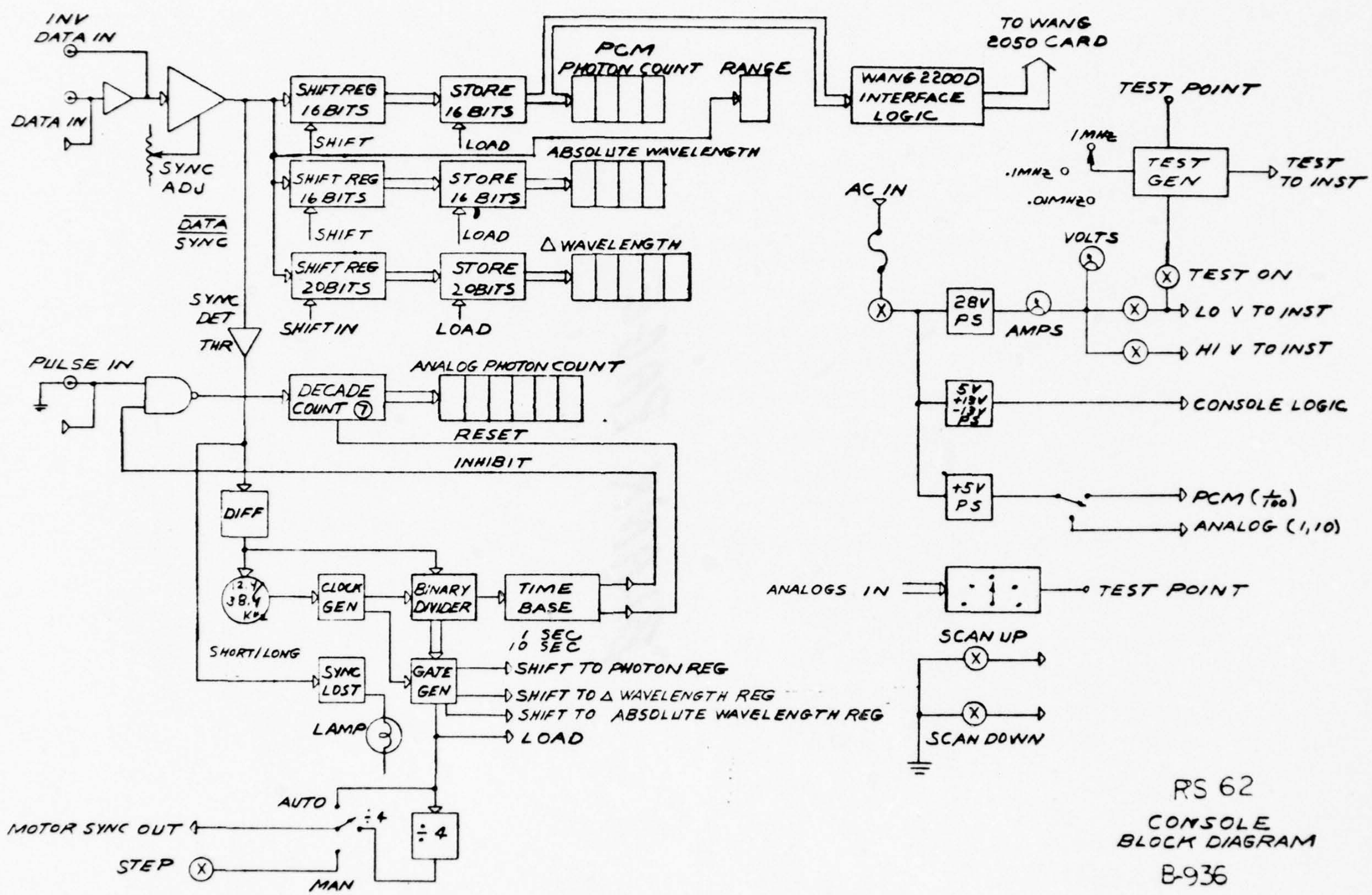

Figure 21. Console Block Diagram - RS-62

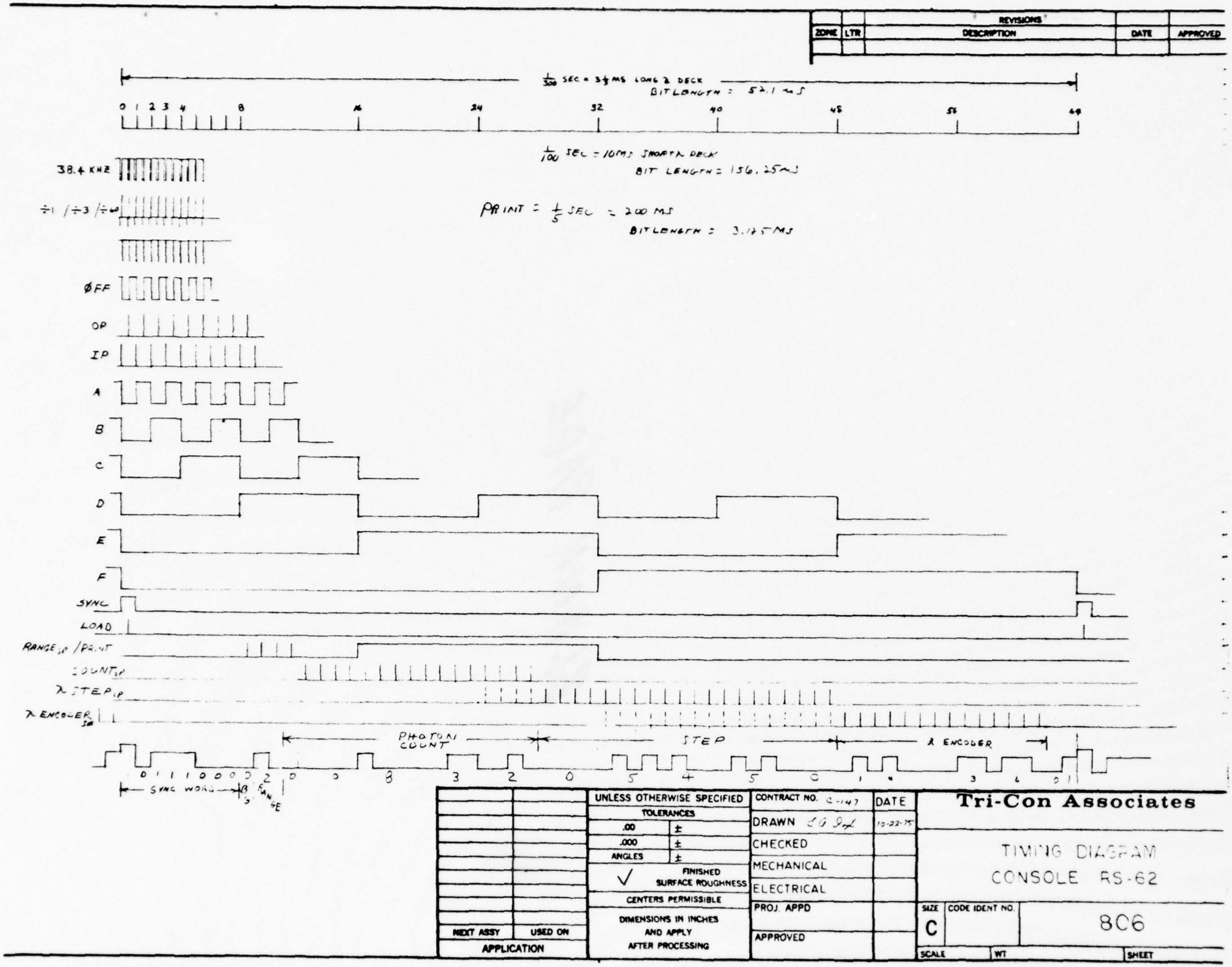

Figure 22. Timing Diagram Console RS-62

The timer card contained the clock oscillator and logic to generate the sample pulses required by the data decoding cards. A schematic is given in Figure 23.

The data decoding cards sampled the PCM data and stored the respective data word in registers to operate the front panel displays, the printer drive card, and the digital to analog converter. Schematics of the cards are given in Figures 24 and 25.

The time base card generated the 1-second and 10-second time bases for the 7-digit decade scaler, also contained on the card. This is illustrated in Figure 26.

The BCD information used to drive the displays was converted on the printer drive card from 0 volts and +5 volts for 0 and 1, respectively, to 0 volts and -6 volts required by the printer. A schematic is given in Figure 27.

The photon count BCD information was converted to an analog voltage by an Analog Devices, Inc. digital-to-analog converter Model DAC-12QZ located on the Wang drive card. Three BCD digits were converted to a 10-volt full scale output with a linearity error of ± the least significant bit. The analog output was useful for producing an intensity versus wavelength plot from magnetic tape of the flight data.

5.4 Performance

The console was used to operate the instrument during calibration. It was used at Ball Brothers Research Corporation for the integration and performance tests. At the launch site the instrument in the tower was operated and set in the proper mode for launch by the console located in the blockhouse.

Immediately after launch, the console was used to produce quick-look data reduction at the site telemetry station.

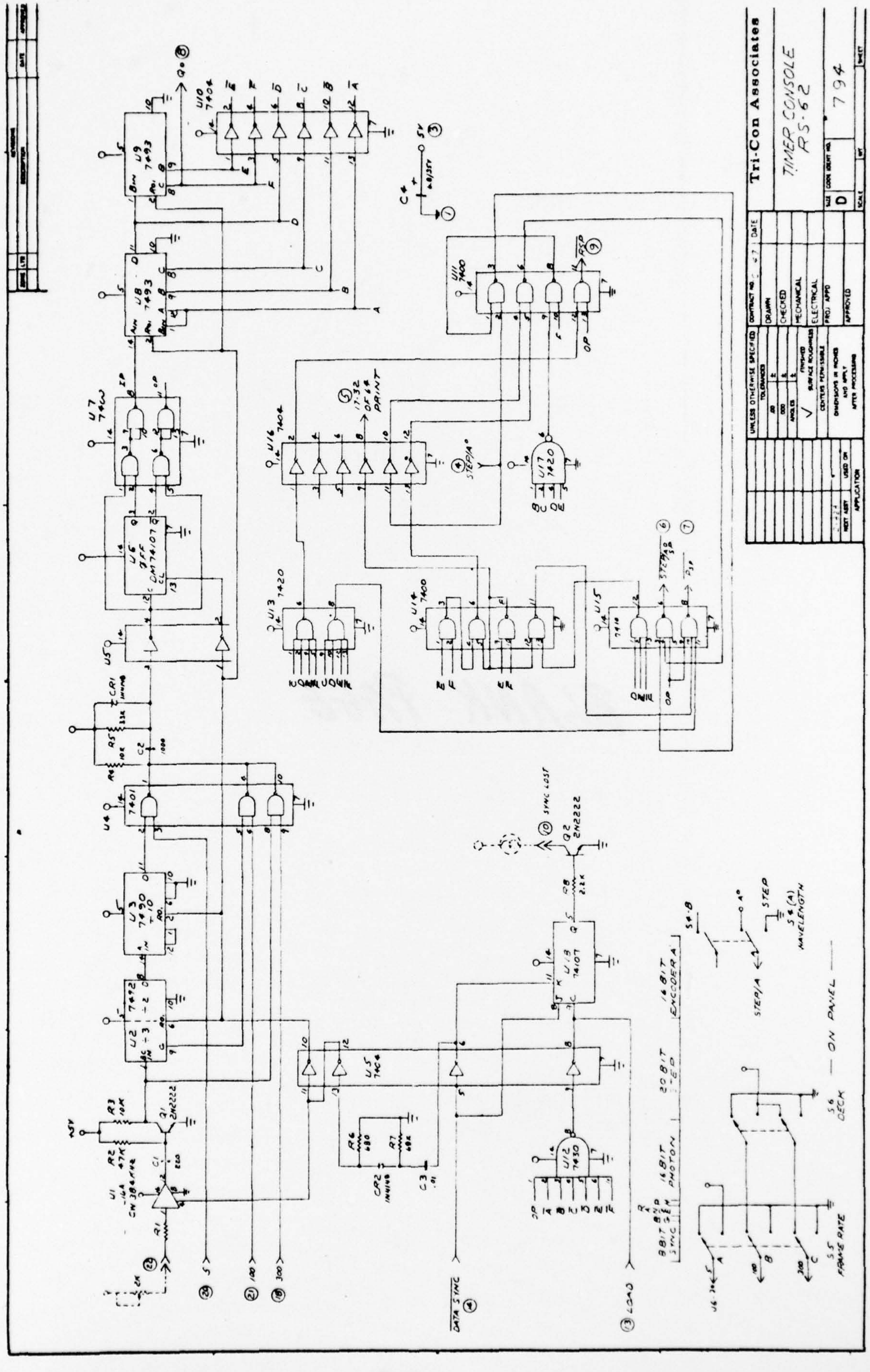

Figure 23. Timer Console RS-62

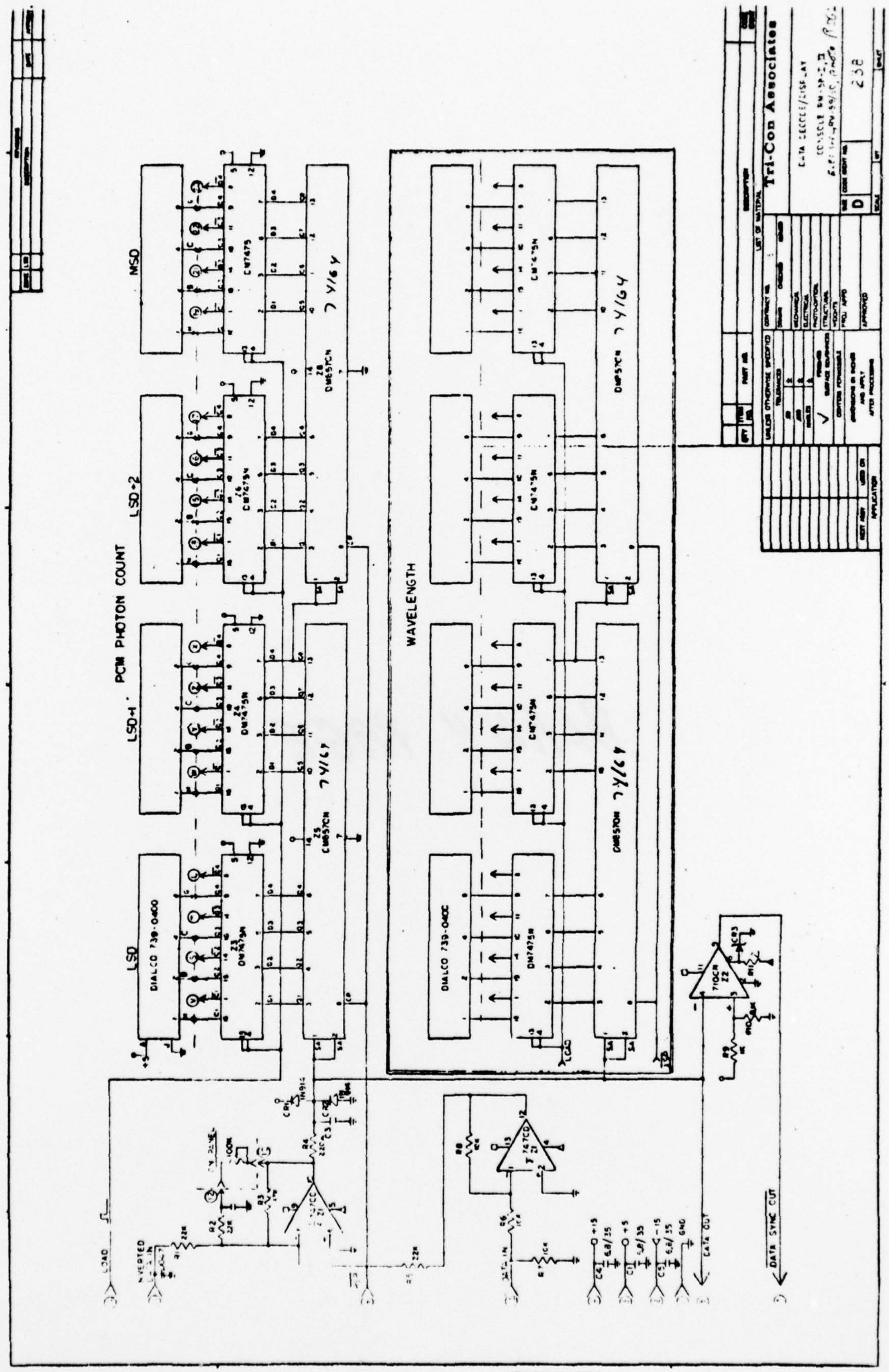

Figure 24. Data Decode/Display

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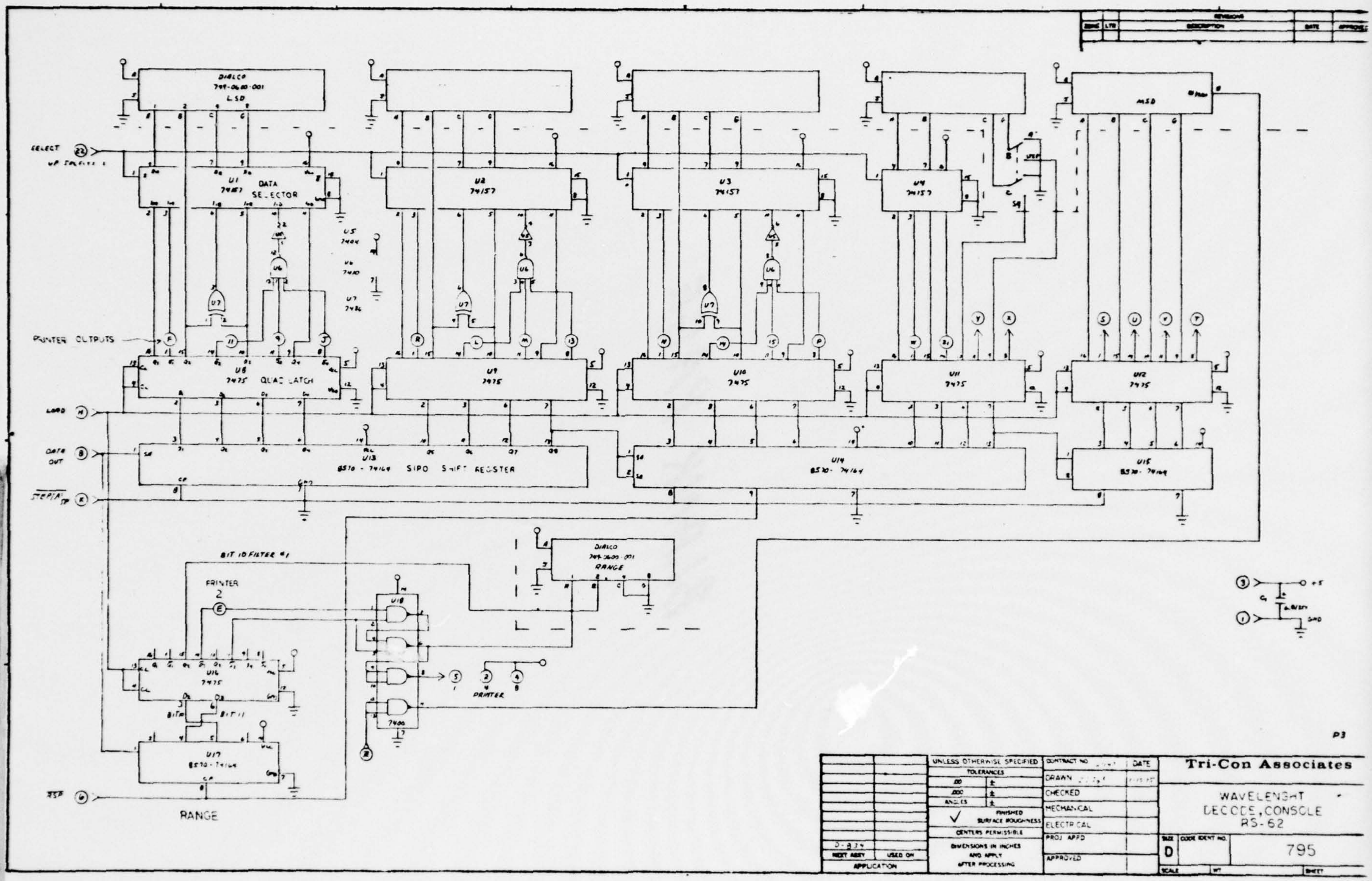

Figure 25. Wavelength Decode, Console RS-62

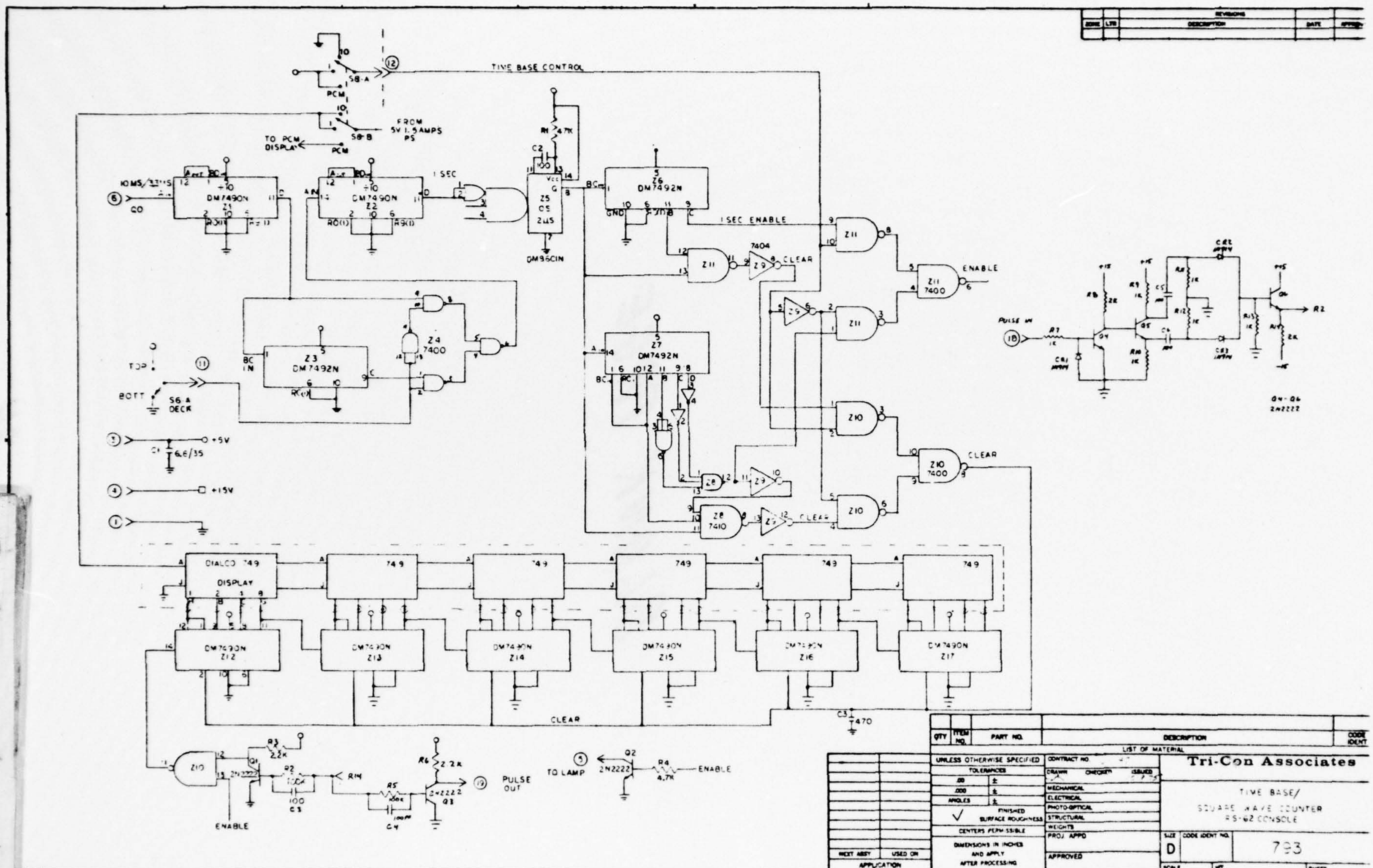

Figure 26. Time Base/Square Wave Counter RS-62 Console

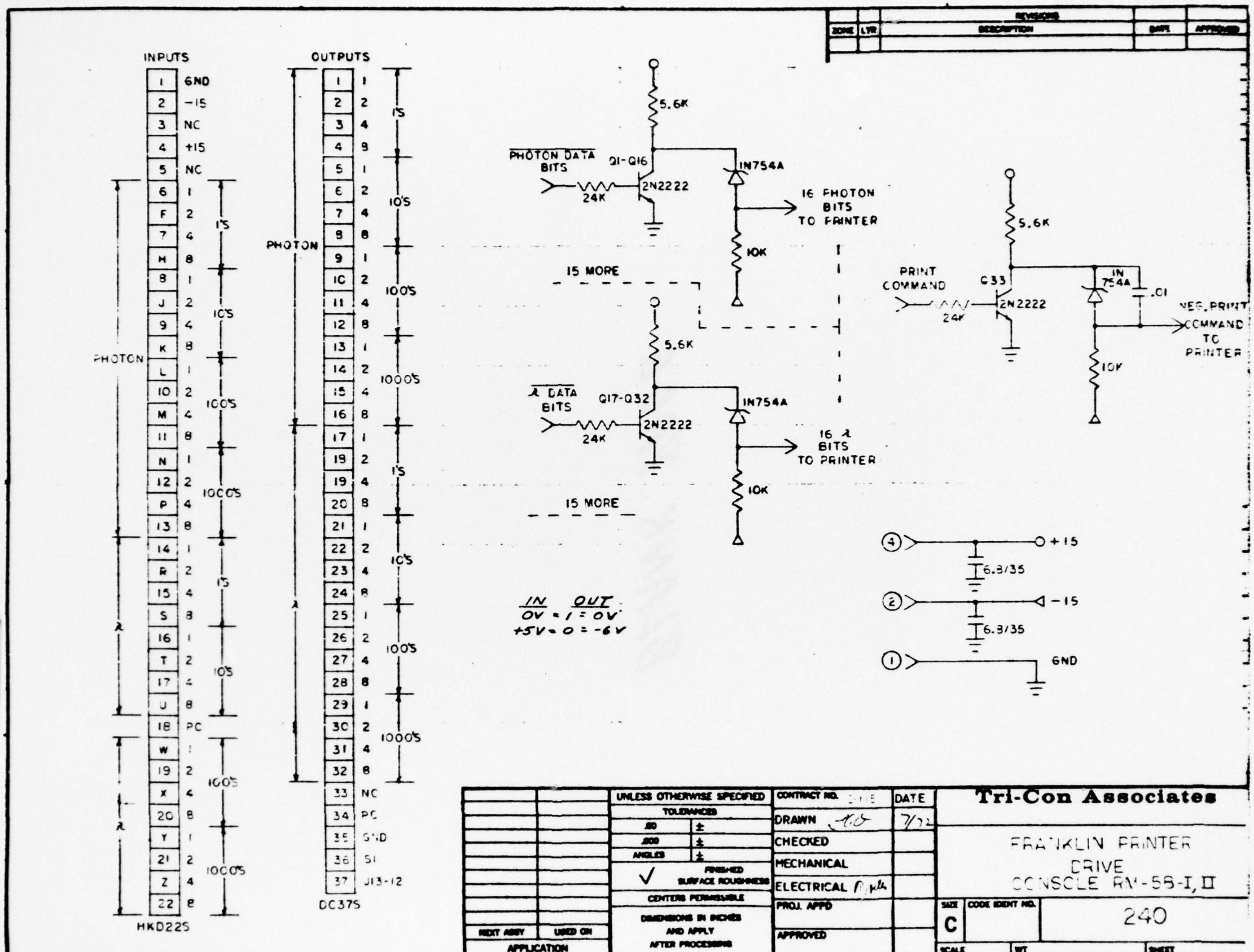

Figure 27. Franklin Printer Drive Console RS-62

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6. FIELD SUPPORT SERVICES

This instrument was launched on 9 August 1977 from White Sands Missile Range, New Mexico. Complete information on the payload integration and launch is contained in a letter report in the Appendix.

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APPENDIX A

MPS-161

True Copy

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REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

1.0 General

1.1 This specification controls the sequence and procedures to be followed in the brazing and subsequent heat treatment and stabilization of the Model 5033 Spectrometer Housing.

2.0 Applicable Documents

Drawings

Spectrometer Housing Brazing Detail	C1288
Housing - Right Half	E398
Housing - Left Half	E397
Stabilization Spec.	MPS-159

3.0 Materials

Housing R & L	6061-T6 Alum. Alloy
Brazing Alloy	Alcoa #718

4.0 Procedure

4.1 Assemble housing as shown on Dwg. C1288 with a 5 mil brazing filler alloy between all ribs and contiguous surfaces at the housing interface.

4.2 Align housing with aluminum pins through holes marked "A" as shown on the drawing. Clamp as necessary to assure good braze joints at all mating surfaces with minimum distortion of the housing.

4.3 Salt bath dip braze housing at 1080°-1090°F. Keep braze joint horizontal to prevent filler alloy flow from joint.

4.4 Remove housing from salt bath and allow to still air cool to approximately 970°F ± 10°F.

4.5 Air blast quench from 970°F with a strong air flow around and through entire housing.

4.6 Artificially age and thermal cycle per Sections 3.4, 3.5, and 4.0 of MPS-159.

COMSTOCK & WESCOTT, INC. CAMBRIDGE, MASSACHUSETTS			SPECTROMETER HOUSING BRAZING SPECIFICATION	
CONTRACT NO. 75-0198	PREPARED BY J.F.McGrath	DATE 10/6/76		
PROJECT NO. 5033	REVIEWED BY		CODE IDENT NO. 31561	MPS -161
REV.	APPROVED BY	10-6-76		SHEET 1 OF 1

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APPENDIX B

TRUE COPY

LETTER REPORT ON
LAUNCH OF ROCKET SPECTROMETER NO. 62
FROM WHITE SANDS MISSILE RANGE
NEW MEXICO
ON 9 AUGUST 1977

Date of Report: 19 August 1977

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LETTER REPORT ON
LAUNCH OF

AFGL	RS-62
Vehicle No.	A03.509-1
Launch Date	9 August 1977
Time	1010 MDT
Site	White Sands Missile Range, New Mexico

Contract No. F19628-75-C-0198
Date of Report: 19 August 1977

Author: Robert S. Hills
Robert S. Hills, Engineer
Tri-Con Associates, Inc.

Approved by:
Richard B. Walker, Vice President
Operations-Comstock & Wescott, Inc.

Prepared for
Air Force Geophysics Laboratory (AFGL)
Hanscom Air Force Base, Mass. 01731

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Air Force Geophysics Laboratory
Department of the Air Force
Hanscom Air Force Base, Mass. 01731

Attention: Mr. Charles W. Chagnon (LKO)
Aeronomy Laboratory

Subject: Letter Report on Launch of Rocket Spectrometer No. 62 from White Sands Missile Range, New Mexico on 9 August 1977.

Gentlemen:

The launch and flight of Rocket Spectrometer No. 62 were accomplished on 9 August 1977 in accordance with AFSC Management Report dated 23 June 1977.

Integration At Boulder Colorado

The Spectrometer Instrument RS-62 was integrated with its Solar Pointing Control and Telemetry System during the week of 25 July 1977 at Ball Brothers Research Corporation (BBRC), Boulder, Colorado.

There were no problems with mechanical fit. The eyeblock was mounted with a 0.020 inch shim under one end to correct for internal optical misalignment.

The instrument was nose heavy and required about 15 pounds of lead at the rear to achieve the balance necessary for the elevation servo to function properly. Pointing checks were made to provide data for possible changes in the servo time constants. A performance check was not made at Boulder.

After minor corrections were made to the printing control wiring, the operation of the instrument was satisfactory. The photometer leakage current was 5×10^{-11} amperes instead of 5×10^{-13} amperes which has been achieved at AFGL. However, there had been 2 days of rain in Boulder and the humidity was very high.

The telemetry bit rate of the top deck PCM signal was 19.2 kilobits per second, almost twice as high as had previously been used. A wide band low pass filter for the local telemetry ground station was not available so the tunable discriminator/filter at AFGL was shipped to Boulder and arrived Wednesday morning. Telemetry checks were then successfully performed. The console was used to strip out data from the tunable discriminator/filter and qualitative "aliveness" checks were made.

The equipment was readied for shipment to WSMR Friday morning, loaded Friday afternoon, and was at WSMR on Monday 1 August.

Launch Preparations at WSMR

The instrument was checked Monday 1 August and operated correctly including the photometer which read 2×10^{-13} amperes.

A preflight conference was held at 1230 hours 2 August. Launch was confirmed for 1000 hours 9 August.

In the afternoon an attempt was made to evacuate the nose cone (with instrument). Loose screws on the inside of the vacuum hose fitting leaked badly. A shear pin sheared on the dog motor drive when the motor was energized to raise the cone. It was discovered that the dog mechanism had over-traveled on closure due to a malfunctioning limit switch. The overtravel prevented releasing the dogs by the usual method of applying pressure to the mechanism through a pipe plug hole in the cone rim. The cone was finally raised by loosening the screws holding the dog guides to the base plate. The failure of the limit switch was caused by a drop of epoxy under the actuating lever. This epoxy had dripped from the instrument umbilical connector when it was potted at Boulder.

A performance check was run in building N200 Wednesday morning. The pointing control performed well, but the "Bottom Test On" function at the console controlled both motors.

BBRC found incorrect wiring in the F Section and it was corrected. During the check, counts were observed on the bottom deck telemetry signal during high voltage "On" time. The trouble could not be reproduced after the check.

Dr. Bedo and Mr. Swirbalus ran a calibration check on the upper deck using the Pen Ray Lamp and calibrated diode.

The Horizontal Check was run at the VAB at 1030 hours Thursday. The counts (2000 per second) appeared again during the run. It was determined that the counts were present only with the pullaway out. The trouble had not been noticed at Boulder or AFGL because the console had always been connected. The only way to operate without external connections was on battery while observing the telemetry signals. This was not done until the performance and horizontal checks in the field.

A capacitor (.01 MFD) was added to the 28 volt input to the bottom high voltage power supply at the F Section terminal board. This reduced the count to zero. The proper operation was confirmed by further checks using telemetry on Friday morning.

On Monday morning, 8 August, the payload was raised to the fourth level of the 150 B tower, the rocket loaded and the payload lowered and mated to the rocket.

Land lines were checked by BBRC and the instrument was energized from the console in the blockhouse. Some a-c ripple was present which made it difficult, but not impossible, to synchronize the console clock to the PCM signal. In future instruments it may be advisable to increase the difference between the sync pulse amplitude and data amplitude.

The Vertical Check was run at 1400 hours Monday. Performance was satisfactory. Photometer leakage current read 5×10^{-11} amperes with the pullaway in but dropped to 4×10^{-13} amperes with the pullaway out. The console was taken to the tower and connected directly to the instrument and the low leakage of 4×10^{-13} amperes was confirmed.

The "aliveness" of the short wavelength deck was checked by removing a cover and inserting the Pen Ray Lamp in front of the exit slit.

BBRC installed flight squibs and the instrument was cleaned and buttoned up. A successful check was made with the console in the blockhouse.

On attempting to rough on the cone a leak was discovered between the G and F Sections. (A vacuum in the cone also produced a vacuum in the F Section.) The cone was raised and the G and F Sections including the instrument were laid on the third level deck. A screw which had been loosened on the previous Wednesday to raise the nose cone after the shear pin had broken was found to be still loose. It was tightened, the payload reassembled, and a good roughing vacuum obtained.

Launch and Results

The rocket was launched at 1010 hours Tuesday 9 August 1977, after a 10 minute hold due to pressurization problems. The console was carried from the blockhouse to the N200 telemetry station and was feeding good data to the analog recorder when signals began to be returned at high voltage turn on at about plus 100 seconds. Both decks apparently operated correctly including insertion of background and neutral density filters at the proper times.

The photometer current (ion) increased from 1×10^{-10} amperes at nose cone "Up" to 2.2×10^{-10} amperes over most of the flight, decreasing to 0.8×10^{-10} amperes for the last 30 seconds before restow.

The payload was picked up by helicopter and returned to building N200. It appeared undamaged so the nose cone was raised and the instrument removed. It was energized from the console and operated satisfactorily. It was returned to AFGL for future use.

Very truly yours,

Robert S. Hills

Robert S. Hills
Senior Engineer
Tri-Con Associates, Inc.
(Subcontractor)

RSH:mrs